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STUDIES OF SELECTED RIPARIAN AREAS WITHIN THE CALIFORNIA DESERT CONSERVATION AREA

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February 28, 1979

Attention: Mr. Albert S. Endo
Contracting Officer's Authorized Representative

In re: Submittal of Studies of Selected Riparian Areas
Within the California Desert Conservation Area;
Contract No. CA-060-CT8-70
Tetra Tech Contract No. TC-3264

Gentlemen:

In accordance with Contract No. CA-060-CT8-70, I am pleased to submit herewith the Final Report of Studies of Selected Riparian Areas Within the California Desert Conservation Area.

The report documents the existing status of water quality and water rights within three selected riparian locations:

- San Sebastian Marsh
- Harper Dry Lake area
- Afton Canyon

Guidelines for the future management of these area are presented.

Support materials furnished by your office for this project are being returned under separate cover.

We greatly appreciated the opportunity of assisting the Desert Planning Staff with our services.

Respectfully submitted,

Robert G.B. Sener, Ph.D.
Project Manager
Environmental Services Department
Engineering Division

RGBS:sd

Enclosures: As stated above

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STUDIES OF SELECTED RIPARIAN AREAS WITHIN THE CALIFORNIA DESERT CONSERVATION AREA

Contract No. CA-060-CT8-70
Tetra Tech Contract No. TC-3264

Prepared for:

U.S. Department of the Interior
Bureau of Land Management
Desert Planning Staff
3610 Central Avenue, Suite 402
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Prepared by:

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February 1979

ABSTRACT

The following report presents the results of water quality and water rights investigations of three environmentally sensitive areas within the California Desert Conservation Area. These areas are:

- San Sebastian Marsh
- Harper Dry Lake Area
- Afton Canyon

Water quality data include biological, chemical, and physical parameters. The water rights information includes data on the ownership and land use status of sections and parcels within the selected study areas and an analysis of existing water rights within the context of the California Doctrine.

The final section of the report presents general guidelines for the development of management programs specifically designed for each of the three selected riparian study areas.

PROFESSIONAL STAFF

This study was designed and written by Robert Sener, the Project Manager. Technical expertise and support were provided by the following members of the professional staff:

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Madeleine Orys, B.S.....Physical analyses

Raymond F. Rodrigue, Ph.D.....Quality Assurance

Robert G.B. Sener, Ph.D.....Biological and chemical analyses

Fred Stern, B.S.....Initial sorting of benthic fauna

Laboratory analyses of water constituents were performed by Mr. Soloukid Pourian.

TABLE OF CONTENTS

Section	Title	Page Number
--	LETTER OF TRANSMITTAL.....	
--	ABSTRACT.....	i
--	PROFESSIONAL STAFF.....	ii
--	LIST OF TABLES.....	vii
--	LIST OF FIGURES.....	ix
--	LIST OF PLATES.....	x
--	LIST OF APPENDICES.....	xii
1.0	INTRODUCTION.....	1
	1.1 Background.....	1
	1.2 Geographical Context.....	1
	1.2.1 San Sebastian Marsh.....	3
	1.2.2 Harper Dry Lake Area.....	3
	1.2.3 Afton Canyon.....	7
	1.3 General Descriptions.....	7
	1.3.1 San Sebastian Marsh.....	7
	1.3.2 Harper Dry Lake Area.....	9
	1.3.3 Afton Canyon.....	10
2.0	FIELD AND LABORATORY ANALYSES.....	12
	2.1 Materials and Methods.....	12
	2.1.1 Biological Parameters.....	12
	2.1.2 Chemical Parameters.....	20
	2.1.2.1 *Field Procedures*.....	20
	2.1.2.2 *Laboratory Procedures*.....	22
	2.1.3 Physical Parameters.....	23
	2.2 Results.....	24

TABLE OF CONTENTS (Cont'd.)

Section	Title	Page Number
2.0	Continued	
	2.3 Discussion.....	24
	2.3.1 San Sebastian Marsh.....	24
	2.3.1.1 *Biological Parameters*.....	24
	2.3.1.2 *Chemical Parameters*.....	40
	2.3.1.3 *Physical Parameters*.....	41
	2.3.2 Harper Dry Lake Area.....	42
	2.3.2.1 *Biological Parameters*.....	42
	2.3.2.2 *Chemical Parameters*.....	43
	2.3.2.3 *Physical Parameters*.....	44
	2.3.3 Afton Canyon.....	44
	2.3.3.1 *Biological Parameters*.....	44
	2.3.3.2 *Chemical Parameters*.....	45
	2.3.3.3 *Physical Parameters*.....	46
3.0	LAND USE AND WATER RIGHTS.....	47
	3.1 Existing Land Use and Ownership Status.....	47
	3.1.1 San Sebastian Marsh.....	47
	3.1.2 Harper Dry Lake Area.....	47
	3.1.3 Afton Canyon.....	54
	3.2 Existing Water Rights Status.....	62
	3.2.1 San Sebastian Marsh.....	62
	3.2.2 Harper Dry Lake Area.....	63
	3.2.3 Afton Canyon.....	63

TABLE OF CONTENTS (Cont'd.)

Section	Title	Page Number
3.0	Continued	
	3.3 Projected Water Rights Trends.....	64
	3.3.1 San Sebastian Marsh.....	64
	3.3.2 Harper Dry Lake Area.....	65
	3.3.3 Afton Canyon.....	65
4.0	EVALUATION OF EXISTING CONDITIONS AND PROJECTED TRENDS.....	67
	4.1 San Sebastian Marsh.....	67
	4.1.1 Land Use.....	67
	4.1.2 Water Quality.....	67
	4.1.3 Water Rights.....	69
	4.2 Harper Dry Lake Area.....	70
	4.2.1 Land Use.....	70
	4.2.2 Water Quality.....	71
	4.2.3 Water Rights.....	73
	4.3 Afton Canyon.....	73
	4.3.1 Land Use.....	73
	4.3.2 Water Quality.....	74
	4.3.3 Water Rights.....	75
5.0	RECOMMENDED MANAGEMENT GUIDELINES.....	77
	5.1 San Sebastian Marsh.....	77
	5.2 Harper Dry Lake Area.....	81
	5.3 Afton Canyon.....	83

TABLE OF CONTENTS (Cond'd.)

Section	Title	Page Number
6.0	LITERATURE CITED.....	85
--	APPENDICES A THROUGH F.....	

LIST OF TABLES

Table Number	Title	Page Number
2.1-1	PARAMETERS, UNITS, AND METHODS	13
2.1-2	FIELD EQUIPMENT	16
2.2-1	BACTERIOLOGICAL ANALYSES OF SAN FELIPE CREEK WATER SAMPLED WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1500 HOURS (3:00 PM)	25
2.2-2	CHEMICAL ANALYSES OF SAN FELIPE CREEK WATER SAMPLED WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1500 HOURS (3:00 PM)	26
2.2-3	PHYSICAL MEASUREMENTS OF SAN FELIPE CREEK MADE WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1530 HOURS (3:30 PM)	27
2.2-4	ANALYSES OF SAN FELIPE CREEK SEDIMENTS SAMPLED WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1600 HOURS (4:00 PM)	28
2.2-5	BENTHIC INVERTEBRATE FAUNA OF A POOL WITHIN THE HARPER DRY LAKE AREA SAMPLED ON NOVEMBER 29, 1978 AT 1415 HOURS (2:15 PM)	29
2.2-6	BACTERIOLOGICAL ANALYSES OF HARPER DRY LAKE AREA WATER SAMPLED ON NOVEMBER 29, 1978 AT 1230 HOURS (12:30 PM)	30
2.2-7	CHEMICAL ANALYSES OF HARPER DRY LAKE AREA WATER SAMPLED ON NOVEMBER 29, 1978 AT 1230 HOURS (12:30 PM)	31
2.2-8	PHYSICAL MEASUREMENTS OF HARPER DRY LAKE AREA WATER MADE ON NOVEMBER 29, 1978 AT 1330 HOURS (1:30 PM)	32
2.2-9	ANALYSES OF SEDIMENTS OBTAINED FROM MARSHY PORTIONS OF THE HARPER DRY LAKE AREA ON NOVEMBER 29, 1978 AT 1415 HOURS (2:15 PM)	33
2.2-10	BENTHIC INVERTEBRATE FAUNA OF THE MOJAVE RIVER SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1630 HOURS (4:30 PM)	34
2.2-11	BACTERIOLOGICAL ANALYSES OF MOJAVE RIVER WATER SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1530 HOURS (3:30 PM)	35

LIST OF TABLES (Cont'd.)

Table Number	Title	Page Number
2.2-12	CHEMICAL ANALYSES OF MOJAVE RIVER WATER SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1530 HOURS (3:30 PM)	36
2.2-13	PHYSICAL MEASUREMENTS OF THE MOJAVE RIVER AT AFTON CANYON ON DECEMBER 6, 1978 AT 1600 HOURS (4:00 PM)	37
2.2-14	ANALYSES OF MOJAVE RIVER SEDIMENTS SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1630 HOURS (4:30 PM)	38
3.1-1	LAND OWNERSHIP AND USE WITHIN THE SAN SEBASTIAN MARSH STUDY AREA	49
3.1-2	LAND OWNERSHIP AND USE WITHIN THE HARPER DRY LAKE STUDY AREA	51
3.1-3	LAND OWNERSHIP AND USE WITHIN THE AFTON CANYON STUDY AREA A. WESTERN SECTOR B. EASTERN SECTOR	57

LIST OF FIGURES

Figure Number	Title	Page Number
1	THE CALIFORNIA DESERT CONSERVATION AREA	2
2	SELECTED STUDY SITES WITHIN THE CALIFORNIA DESERT CONSERVATION AREA	4
3	SECTIONS COMPRISING THE SAN SEBASTIAN MARSH STUDY AREA	5
4	SECTIONS COMPRISING THE HARPER DRY LAKE STUDY AREA	6
5	SECTIONS COMPRISING THE AFTON CANYON STUDY AREA	8
6	OWNERSHIP STATUS OF THE SAN SEBASTIAN MARSH STUDY AREA	48
7	OWNERSHIP STATUS OF THE HARPER DRY LAKE STUDY AREA	50
8A	OWNERSHIP STATUS OF THE AFTON CANYON STUDY AREA, WESTERN SECTOR	55
8B	OWNERSHIP STATUS OF THE AFTON CANYON STUDY AREA, EASTERN SECTOR	56

LIST OF PLATES

Plate Number	Title	Between Page Numbers
1	THE SAN SEBASTIAN NATURAL AREA IS CLOSED TO OFF-ROAD VEHICLES	9 and 10
2	HARPER'S WELL LIES WITHIN A TRIBUTARY TO SAN FELIPE CREEK	9 and 10
3	EXOTIC TAMARACK HAS EXPLOITED SAN SEBASTIAN TRIBUTARY BEDS	9 and 10
4	THE FINE SUBSTRATE OF THE SAN SEBASTIAN AREA ALLOWS SEVERE EROSION	9 and 10
5	EROSION HAS OCCURRED THROUGHOUT THE SAN SEBASTIAN AREA	9 and 10
6	THE HARPER'S WELL TRIBUTARY JOINS SAN FELIPE CREEK	9 and 10
7	EXTENSIVE MUD AND THE ABSENCE OF VEGETATION CHARACTERIZE SAN FELIPE CREEK	9 and 10
8	THE HARPER DRY LAKE BED IS PARTIALLY COVERED WITH SALT DEPOSITS	10 and 11
9	THE HARPER DRY LAKE BED IS EASILY DISTURBED BY VEHICLE USE	10 and 11
10	CATTLE TRACKS ARE COMMON ALONG THE SOUTHWESTERN MARGIN OF HARPER DRY LAKE	10 and 11
11	IRRIGATION RUNOFF FORMS POOLS ALONG THE SOUTHWESTERN MARGIN OF HARPER DRY LAKE	10 and 11
12	SEDGES INHABIT MARSHY BORDER AREAS OF HARPER DRY LAKE	10 and 11
13	SALT DEPOSITS SURROUND THE SAMPLING SITE AT HARPER DRY LAKE	10 and 11
14	WATER SAMPLES WERE CAUTIOUSLY OBTAINED FROM A SHALLOW POOL AT HARPER DRY LAKE	10 and 11
15	HARPER DRY LAKE SURBER SAMPLES WERE PRESERVED AND SEALED AT THE SITE	10 and 11
16	A ROAD FORDS THE MOJAVE RIVER AT AFTON CANYON	11 and 12
17	RIPARIAN VEGETATION SURROUNDS THE SAMPLING SITE AT AFTON CANYON	11 and 12

LIST OF PLATES (Cont'd.)

Plate Number	Title	Between Page Numbers
18	CLEAR MOJAVE RIVER WATER FLOWS PAST THE SAMPLING SITE AT AFTON CANYON	11 and 12
19	THE AFTON CANYON SITE WAS CLEARED OF DEBRIS AND VEGETATION BEFORE FLOW MEASUREMENT	11 and 12
20	DEPTH IS MEASURED AT CONSTANT INTERVALS ALONG THE MOJAVE RIVER TRANSECT AT AFTON CANYON	11 and 12
21	FLOW IS MEASURED AT PREDETERMINED INTERVALS ALONG THE MOJAVE RIVER TRANSECT AT AFTON CANYON	11 and 12
22	CLOSEUP OF THE PRICE-PYGMY FLOWMETER USED AT AFTON CANYON	11 and 12

LIST OF APPENDICES

Appendix	Title
A	ANNOTATED BIBLIOGRAPHY
B	CONTACTS AND INTERVIEWS
C	INDICATOR BACTERIA FOR WATER QUALITY
D	DERIVATION OF EQUATION FOR DISSOLVED (FREE) CARBON DIOXIDE
E	DETAILS OF PHYSICAL MEASUREMENTS
F	FEDERAL WATER POLLUTION CONTROL ACT
G	WATER QUALITY OBJECTIVES AND PHYSICAL AND HYDROLOGIC CHARACTERISTICS
H	DISCHARGE DATA FOR SAN FELIPE CREEK NEAR WESTMORLAND, CALIFORNIA

1.0 INTRODUCTION

1.1 Background

The Federal Land Policy and Management Act of 1976 established the California Desert Conservation Area (CDCA) to provide "for the immediate and future protection and administration of the public lands in the California Desert within the framework of a program of multiple use and sustained yield, and the maintenance of environmental quality (1)." Title VI of the Act requires the Secretary of the Interior, through the Bureau of Land Management (BLM), to "prepare and implement a comprehensive, long-range plan for the management, use, development, and protection of the public lands" within the CDCA.

Because of their rarity, often ephemeral nature, and sensitivity to surrounding land uses, riparian systems within the CDCA require special and continuing attention. Low-volume desert watercourses are particularly vulnerable to contamination and flow interruption; yet they are a vital component in the maintenance of stable desert ecosystems and in the regional support of wildlife and both xerophytic and riparian vegetation communities. Moreover, desert surface water systems significantly enhance the recreational potential of surrounding lands and may contribute to agriculture, grazing, and residential land use.

This report evaluates the current status and projected trends of hydrologic and water quality conditions for three selected riparian study sites of special concern within the CDCA and provides site-specific management guidelines within the context of existing data, water rights dispositions, and land uses which affect the status of the selected areas.

1.2 Geographical Context

The CDCA contains over 10 million hectares (approximately 25 million acres) and includes about one-fourth of the California land area, as shown in Figure 1. CDCA lands are divided between private and public ownership; about half of the area is National Resource Land administered by BLM, in addition

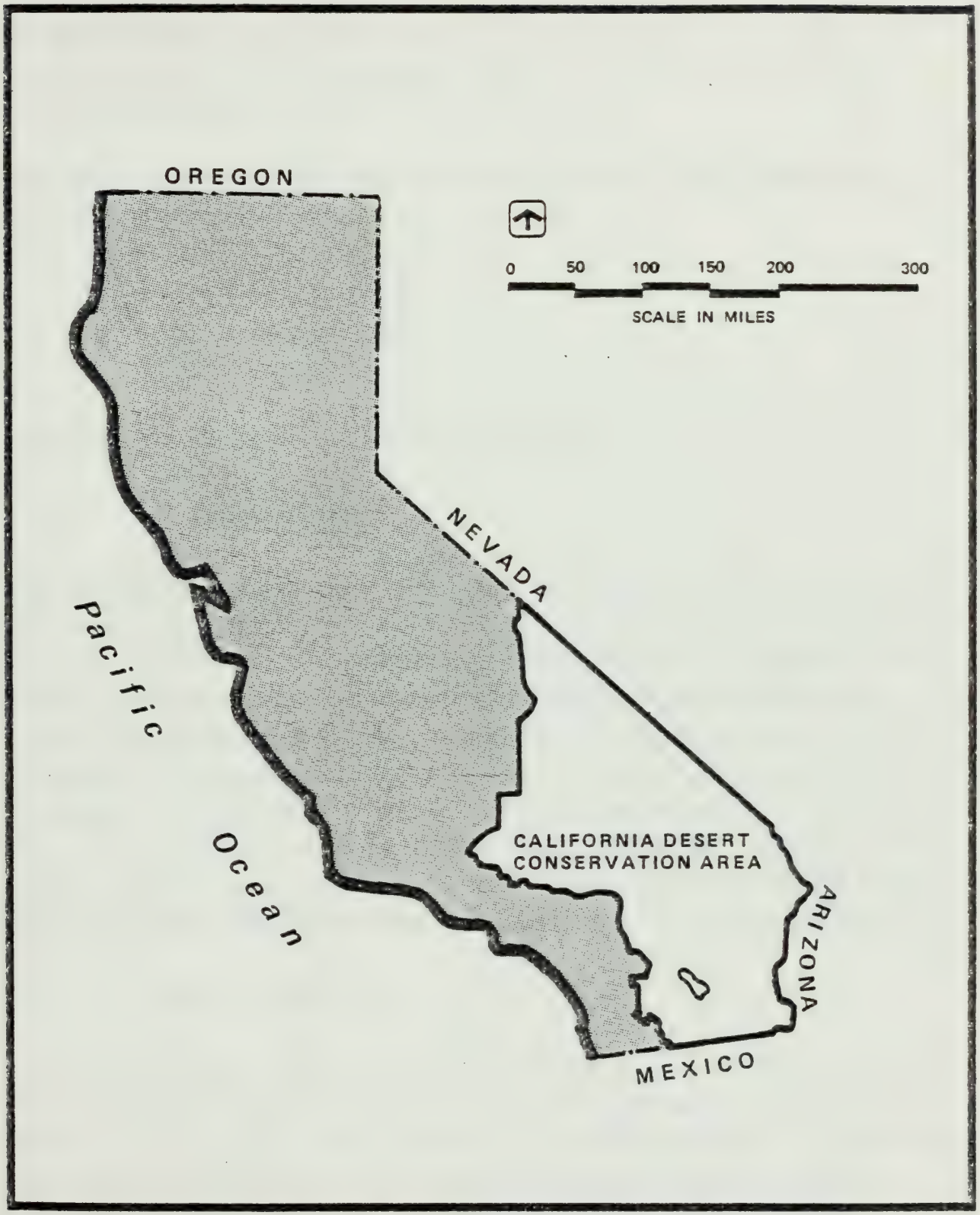

FIGURE 1: THE CALIFORNIA DESERT CONSERVATION AREA.

to approximately 1.2 million hectares (3 million acres) of military reservations and 1 million hectares (2½ million acres) of national and state parklands (2).

The three riparian areas within the CDCA chosen for these studies are as follows:

- San Sebastian Marsh
- Harper Dry Lake Area
- Afton Canyon

Their approximate locations are shown in Figure 2.

1.2.1 San Sebastian Marsh

The San Sebastian Marsh study area, shown in Figure 3, is in Imperial County, California, at T.12S.,R.10E. and T.12S.,R.11E. The water quality sampling location, also indicated in Figure 3, is reached by driving about 56 kilometers (35 miles) north from El Centro on California Highway 86 to the junction with the Old Kane Spring Jeep Trail; following the jeep trail 6.9 kilometers (4.3 miles) west to Harper's Well; and walking approximately 0.8 kilometer (0.5 mile) north along the tributary bed in which Harper's Well lies to the confluence with San Felipe Creek. Biological, chemical, and physical samples were collected and measurements made at San Felipe Creek about 150 meters (500 feet) downstream (east) from the confluence point.

1.2.2 Harper Dry Lake Area

The Harper Dry Lake study area, shown in Figure 4, is a marshy region along the southwestern margin of Harper Dry Lake in San Bernardino County, California, at T.11N.,R.4W. The water quality sampling location, also indicated in Figure 4, is reached by driving 30.9 kilometers (19.2 miles) west on California Highway 58 from the intersection of 1st and Main Streets in Barstow to the junction with Harper Lake Road; proceeding north on Harper Lake Road 9.5 kilometers (5.9 miles) to the junction with Lockhart Road;

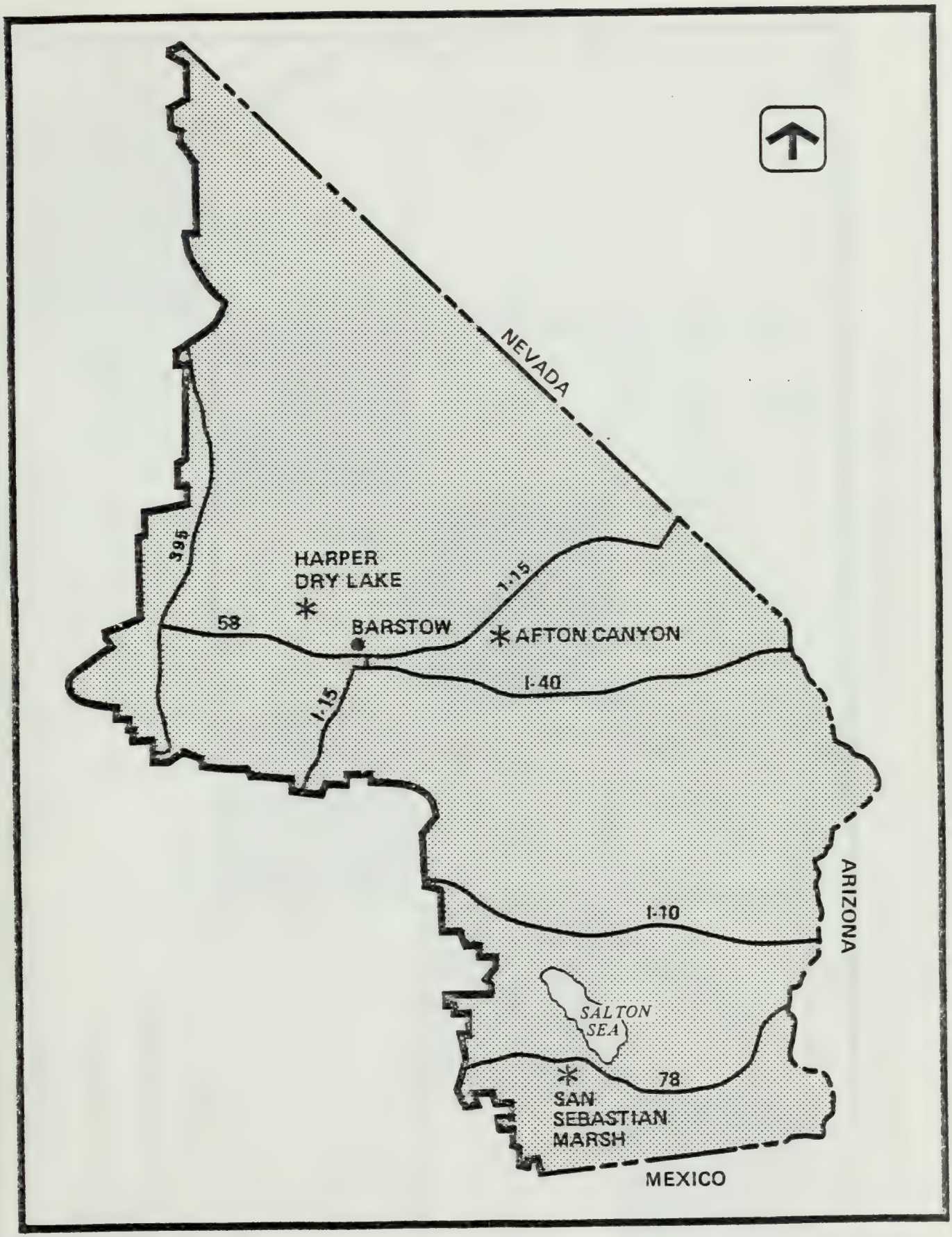

FIGURE 2: SELECTED STUDY SITES WITHIN THE CALIFORNIA DESERT CONSERVATION AREA.

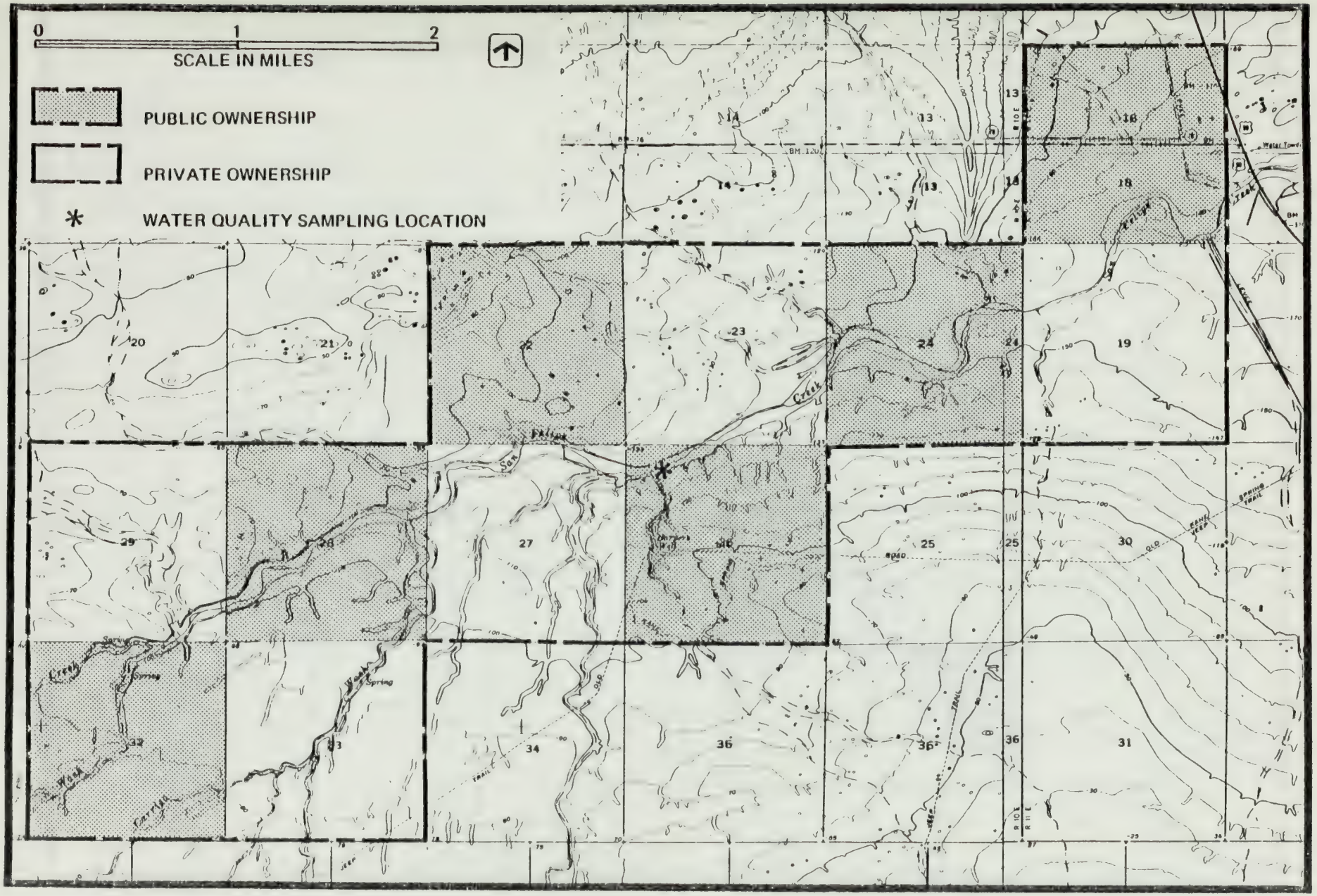

Figure 1. San Sebastian Marsh Area. . T. 12 S., R. 10 E.; T. 12 S., R. 11 E.

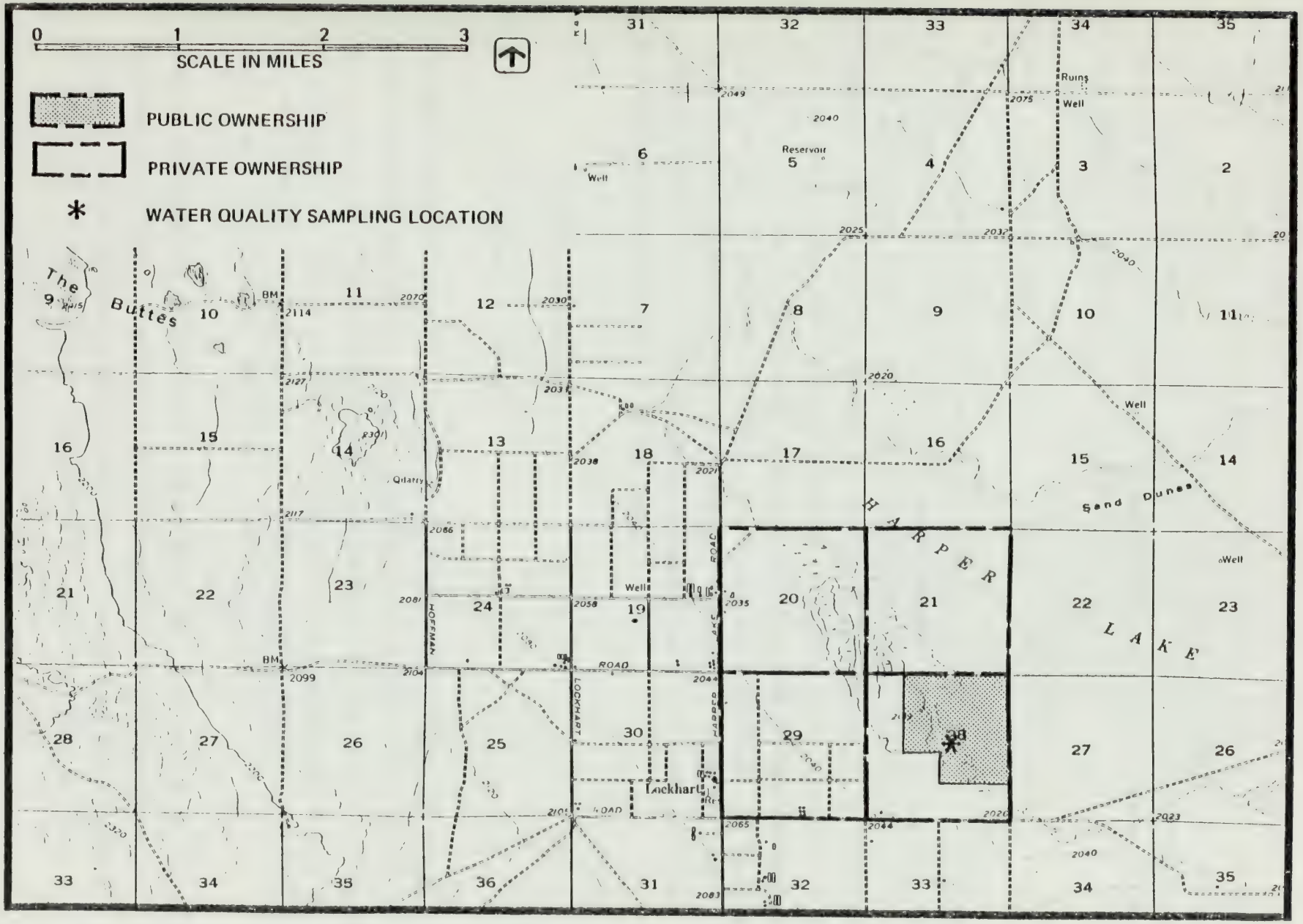

FIGURE 4: SECTIONS COMPRISING THE HARPER DRY LAKE STUDY AREA. T. 11 N., R. 4 W.

following Lockhart Road east 3.5 kilometers (2.2 miles) to a BLM sign reading "Domestic livestock: please do not disturb;" turning left at the sign onto Harper Dry Lake; and proceeding northwest and west 0.6 kilometer (0.4 mile) to the marshy border of the dry lake. Biological, chemical, and physical samples were collected and measurements made at a single shallow pool typical of others in the vicinity.

1.2.3 Afton Canyon

The Afton Canyon study area, shown in Figure 5, is a gorge of varying depth and width cut by the Mojave River in San Bernardino County, California, at T.11N.,R.5E. and T.11N.,R.6E. The water quality sampling location, also indicated in Figure 5, is reached by driving 55 kilometers (34.2 miles) east on Interstate Highway 15 from its junction at Barstow with California Highway 58 to its junction with unpaved, graded Afton Road; and proceeding south on Afton Road 6.4 kilometers (4 miles) through the BLM campground to the point at which Afton Road fords the Mojave River. Biological, chemical, and physical samples were collected and measurements made at the Mojave River immediately upstream (west) from the ford.

1.3 General Descriptions

1.3.1 San Sebastian Marsh

The San Sebastian Marsh is a complex system of tributary beds and floodplains associated with San Felipe Creek. Intermittent rainfall runoff drains via the tributaries into San Felipe Creek and thence into the Salton Sea, about 11 kilometers (7 miles) to the east. The entire area of approximately 15 square kilometers (6 square miles) is below sea level, reaching -55 meters (-180 feet) at the bed of San Felipe Creek.

Flow characteristics within the tributary beds and San Felipe Creek vary with season and rainfall. However, flow in the portion of San Felipe Creek associated with the San Sebastian Marsh is fed by springs approximately 3 kilometers (2 miles) upstream (west) from the sampling site, as shown in

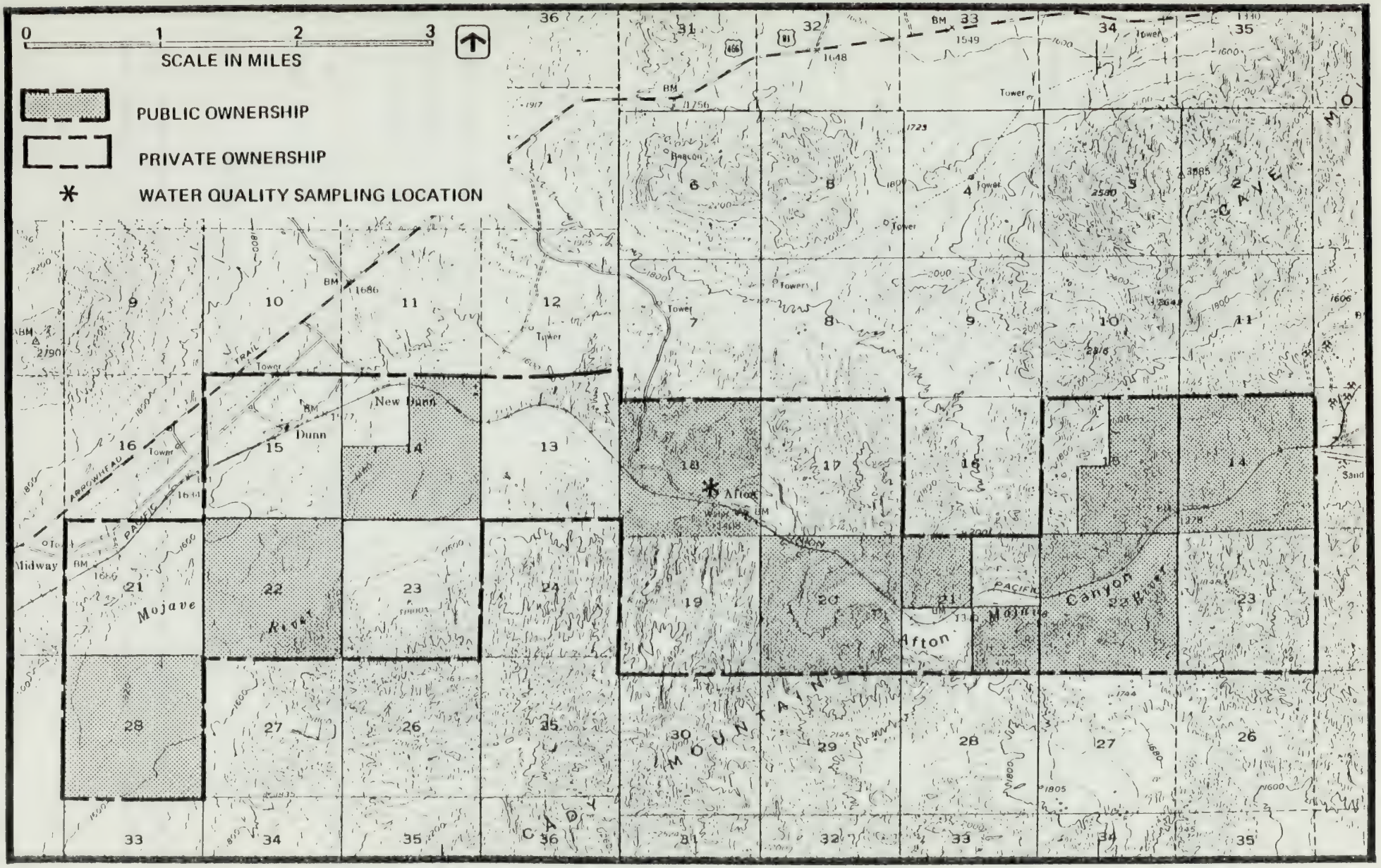

FIGURE 6: SECTIONS COMPRISING THE AFTON CANYON STUDY AREA. T. 11 N., R. 5 E.; T. 11 N., R. 6 E.

Figure 3, and is normally continuous (3). On November 28, 1978, the bed of San Felipe Creek was predominantly exposed as an expanse of deep, soft mud. The almost total absence of vegetation within the creek bed suggests that greater rates of flow and higher water surface levels commonly occur.

Soils throughout the area are fine-grain sediments highly vulnerable to erosion by wind and water. Runoff through the tributary beds has cut a network of deep erosion paths with steep, unstable walls, undisturbed portions of which were observed to collapse spontaneously during the field visit. Much of the mud observed at San Felipe Creek has probably been deposited by runoff flow from the tributaries.

The vegetation composition of the San Sebastian Marsh study area is probably in a state of transition. The visually predominant taxon is exotic tamarack (*Tamarix* spp.), which has exploited the moist tributary beds and banks of San Felipe Creek. The exposed root systems of this genus protruding from the eroded tributary walls indicate that it plays an important role in soil stabilization. Native species such as mesquite (*Prosopis glandulosa*) and mule fat (*Baccharis glutinosa*) are also associated with the tributary beds but are present in smaller numbers than the tamaracks. It is possible that the introduced tamaracks are displacing native species along and within the tributaries. However, creosote bush (*Larrea tridentata*) and mesquite are predominant elsewhere in the area.

Those portions of the study area under BLM jurisdiction have been formally designated the San Sebastian Natural Area and are presently closed to off-road vehicle use.

Plates 1 through 7 provide a general description of the San Sebastian Marsh study area.

1.3.2 Harper Dry Lake Area

The Harper Dry Lake study area is a marshy region extending along the southwest margin of the dry lake bed. Predominant land uses to the immediate

PLATE 1. THE SAN SEBASTIAN NATURAL AREA IS CLOSED TO OFF– ROAD VEHICLES.

PLATE 2. HARPER'S WELL LIES WITHIN A TRIBUTARY TO SAN FELIPE CREEK.

PLATE 3. EXOTIC TAMARACK HAS EXPLOITED SAN SEBASTIAN TRIBUTARY BEDS.

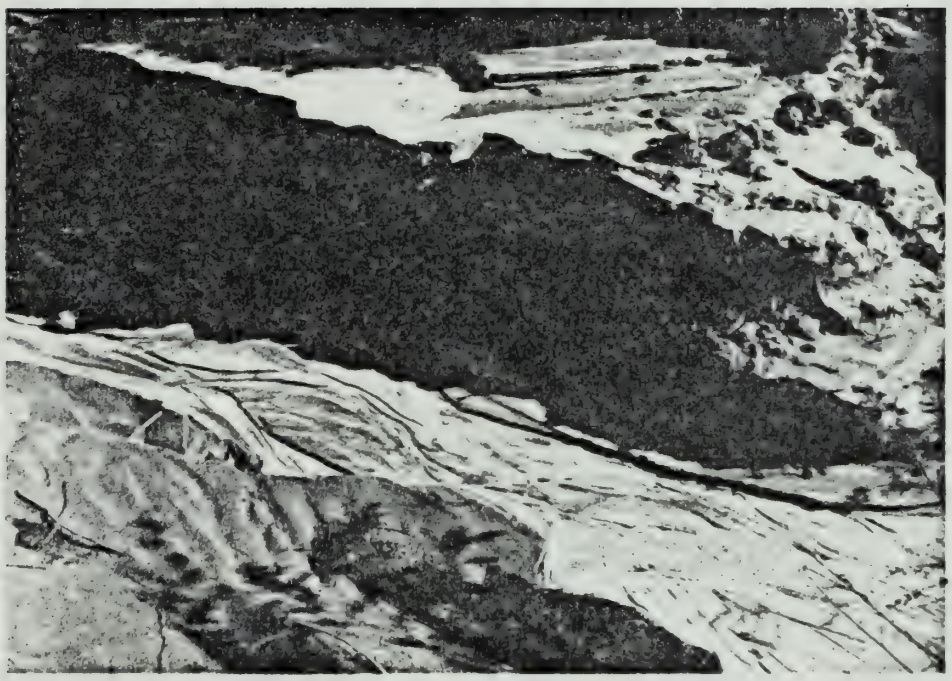

PLATE 4. THE FINE SUBSTRATE OF THE SAN SEBASTIAN AREA ALLOWS SEVERE EROSION.

PLATE 5. EROSION HAS OCCURRED THROUGHOUT THE SAN SEBASTIAN AREA.

PLATE 6. THE HARPER'S WELL LIES WITHIN A TRIBUTARY TO SAN FEFIPE CREEK.

PLATE 7. EXTENSIVE MUD AND THE ABSENCE OF VEGETATION CHARACTERIZE SAN FELIPE CREEK.

south and west are irrigation agriculture and grazing. Alfalfa, hay, and other crops are grown at the nearby Lockhart Ranch and Hays Farm. Irrigation runoff from these agricultural lands has created the marshy fringe, a fragile ecosystem which is actually a by-product of the neighboring human activity. Because of the high salinity of locally available groundwater used for irrigation, tiles were placed below the topsoil of the agricultural land so that irrigation water would not settle, evaporate, and increase soil salinity. The resulting runoff maintains the marshy region (4).

On November 29, 1978, the study area consisted of numerous shallow pools not exceeding 10 centimeters (8 inches) in depth and surrounded by soft substrate supporting an incomplete wetland vegetation community dominated by sedges (*Carex* spp.). Surrounding soils decreased in moisture content with increasing distance from the pools, indicating that evaporation was in progress at the time of the field visit and that the pools were decreasing in volume. The dry lake bed itself was without obvious moisture and was partially covered with salt deposits which in some cases extended to the edges of the pools. The marshy area exuded an odor identical to that produced by decaying vegetation at the seashore.

Visual examination indicates that the Harper Dry Lake study area contributes to the support of a variety of wild and domestic animals. Cattle tracks may be seen throughout the area, and the tracks of shorebirds, mourning doves, and ground squirrels and other rodents are plentiful around and within the pools. Canid tracks are common; these may be produced by coyotes or by the numerous domestic dogs observed in the area. Two shorebird species, the killdeer (*Charadrius vociferus*) and the common snipe (*Capella gallinago*), were observed in and around the pools during the field visit.

Plates 8 through 15 show the Harper Dry Lake study area and some of the sampling procedures employed there.

1.3.3 Afton Canyon

Afton Canyon has been formed by the Mojave River and contains its last surface flow upstream from the Mojave River Sink near Soda Dry Lake, approximately

29 kilometers (18 miles) to the northeast (4). The canyon is about 13 kilometers (8 miles) long, with a southwest-northeast orientation.

The Mojave River originates in the San Bernardino Mountains near Lake Arrowhead and is fed by snowmelt and seasonal rainfall. Downstream flow is controlled by Silverwood Reservoir, which stores water from the Mojave West Fork, and by the Mojave River Forks Dam, which receives flow from the Mojave East Fork as well as from Silverwood Reservoir. During non-flood periods, the river water surfaces and sinks periodically as it percolates into the aquifers along its route past the communities of Victorville, Helendale, Barstow, and Yermo, finally rising at Afton Canyon before disappearing into the Mojave River Sink (4).

At Afton Canyon, the Mojave River supports a riparian plant community dominated by willows (*Salix* spp.), exotic tamarack (*Tamarix* spp.), mule fat (*Baccharis glutinosa*), and grasses. The limpid stream contains dense mats of filamentous green algae (Chlorophyceae) and a heavy growth of periphyton, indicating that flow is probably continuous in the vicinity of the sampling site.

Except for the Afton Road ford, the streambed appears to be undisturbed and contains many pebbles, stones, and rocks. Soils of the area are sandy: generally coarse-grained and non-muddy.

Predominant land uses near Afton Canyon are recreation, transportation, and mineral extraction. The study area is adjacent to a 22-unit BLM campground, and a residence is situated directly southeast of the Afton Road ford. A Union Pacific Railroad right-of-way follows the Mojave River through the canyon.

Plates 16 through 22 show the Afton Canyon study area and some of the field techniques used there.

PLATE 16. A ROAD FORDS THE MOJAVE RIVER AT AFTON CANYON.

PLATE 17. RIPARIAN VEGETATION SURROUNDS THE SAMPLING SITE AT AFTON CANYON.

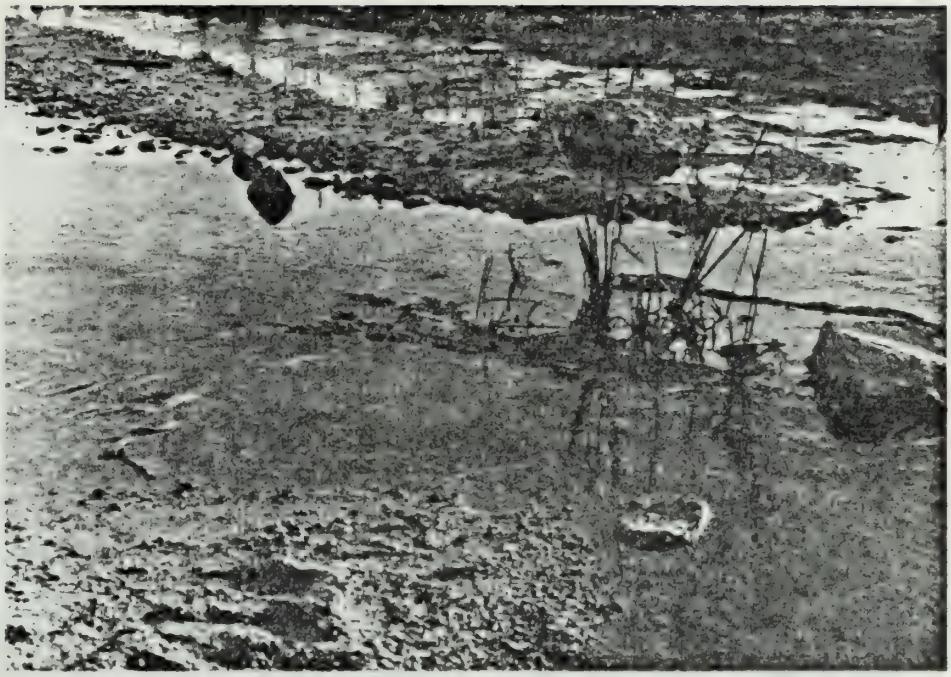

PLATE 18. CLEAR MOJAVE RIVER WATER FLOWS PAST THE SAMPLING SITE AT AFTON CANYON.

PLATE 19. THE AFTON CANYON SITE WAS CLEARED OF DEBRIS AND VEGETATION BEFORE FLOW MEASUREMENT.

PLATE 20. DEPTH IS MEASURED AT CONSTANT INTERVALS ALONG THE MOJAVE RIVER TRANSECT AT AFTON CANYON.

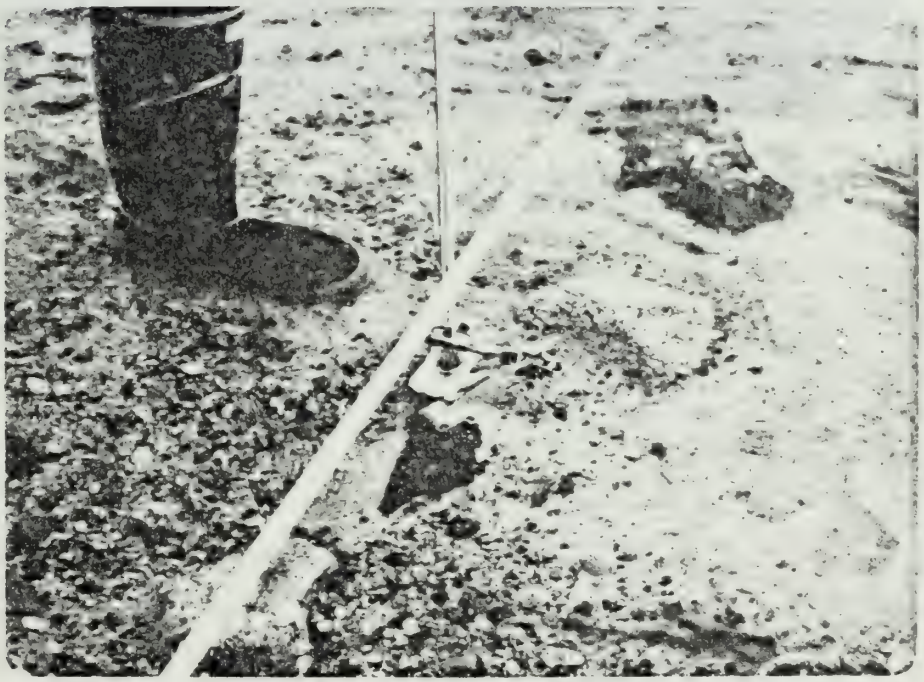

PLATE 21. FLOW IS MEASURED AT PREDETERMINED INTERVALS ALONG THE MOJAVE RIVER TRANSECT AT AFTON CANYON.

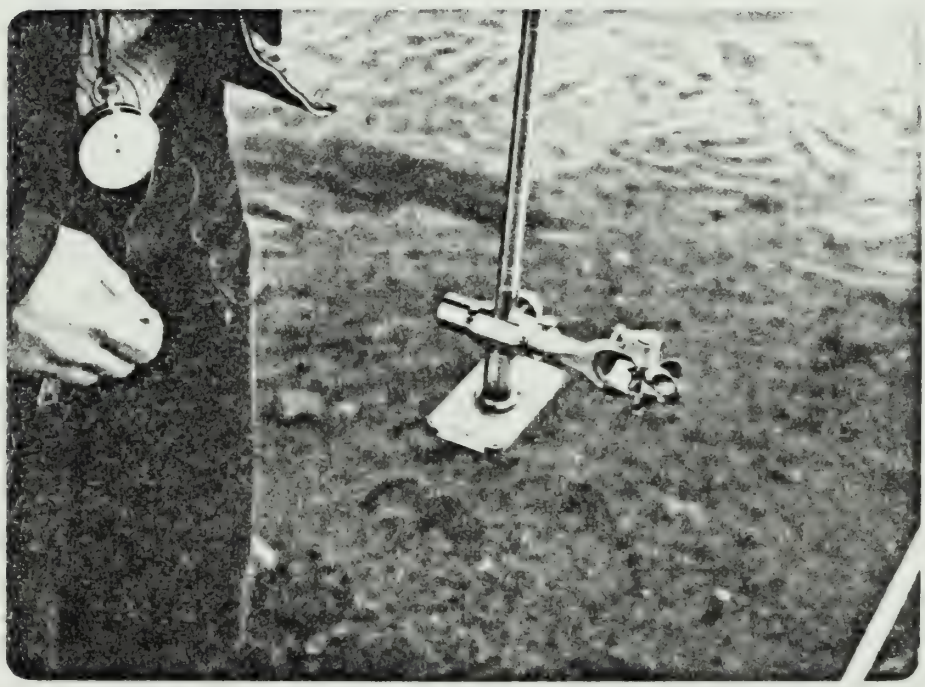

PLATE 22. CLOSEUP OF THE PRICE – PYGMY FLOWMETER USED AT AFTON CANYON.

2.0 FIELD AND LABORATORY ANALYSES

2.1 Materials and Methods

All techniques for the collection and biological, chemical, and physical analyses of samples complied with published approved standard methods (5,6, 7,8,9,10). Table 2.1-1 shows the parameters investigated and the procedures followed. Field equipment is itemized in Table 2.1-2.

2.1.1 Biological Parameters

Benthic macroinvertebrates were collected with a Surber square-foot bottom sampler fitted with side wings to reduce the probability of specimen escape (5). One quantitative sample was obtained from a previously undisturbed substrate area. In cases involving flowing water, this area was upstream of all other sampling and measurement positions. The sample included benthic fauna inhabiting sediment, rocks, and associated vegetation within 929 square centimeters (1 square foot) of streambed. Following immediate labeling and preservation with 10 percent by volume formalin solution, exact counts and taxonomic classifications were made under laboratory conditions using a Wild stereoscopic microscope with 60x through 250x magnifications. Specimens were identified to order level except in cases requiring detailed internal anatomical study, and taxa diagnostic of water quality were further identified to family (11).

Densities of total coliform, fecal coliform, and fecal streptococcus bacteria were determined using the Millipore Corporation field modifications of the standard membrane filter technique (5,12,13). Sample sizes were 0.01, 0.1, 1.0, 10.0, and 25.0 milliliters for total coliform, and 1.0, 10.0, and 50.0 milliliters for fecal coliform and fecal streptococcus bacteria. The criterion for density determination was the largest sample volume with a count within the acceptable range for the type of bacteria in question (5). The acceptable ranges were:

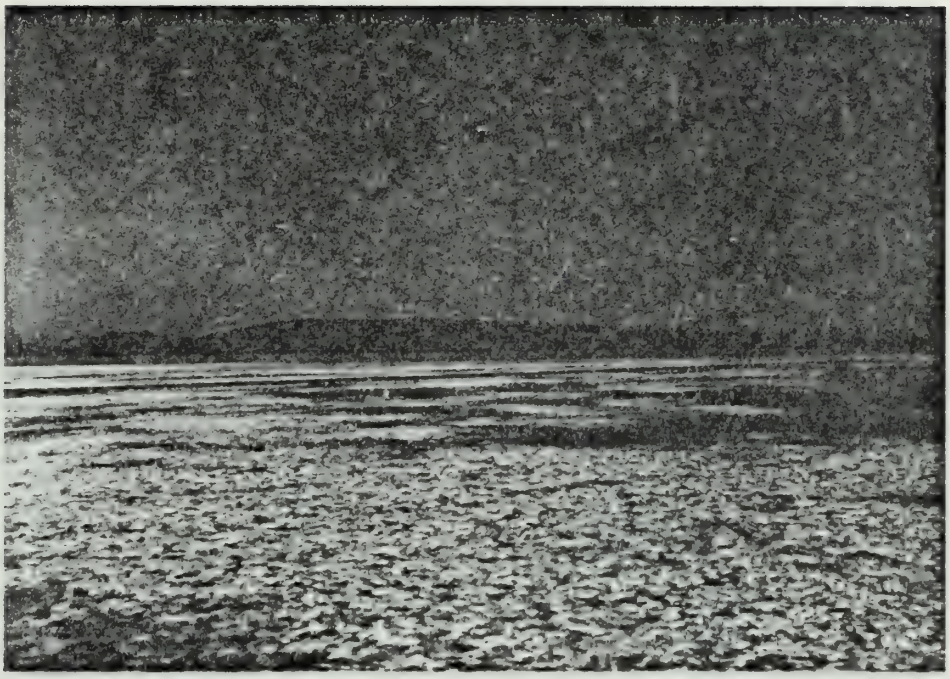

PLATE 8. THE HARPER DRY LAKE BED IS PARTIALLY COVERED WITH SALT DEPOSITS.

PLATE 9. THE HARPER DRY LAKE BED IS EASILY DISTURBED BY VEHICLE USE.

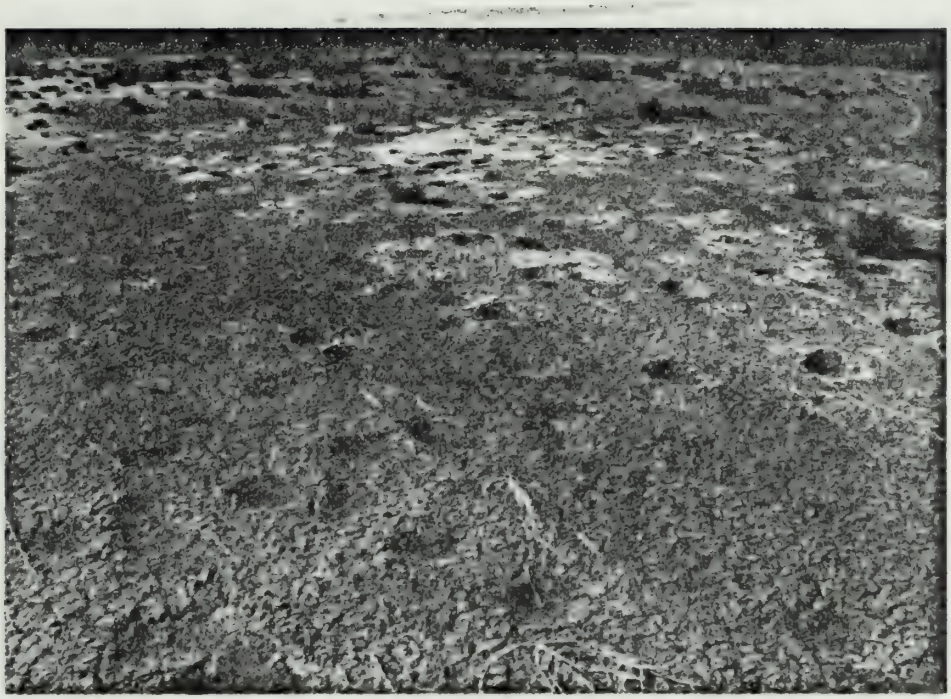

PLATE 10. CATTLE TRACKS ARE COMMON ALONG THE SOUTHWESTERN MARGIN OF HARPER DRY LAKE.

PLATE 11. IRRIGATION RUNOFF FORMS POOLS ALONG THE SOUTHWESTERN MARGIN OF HARPER DRY LAKE.

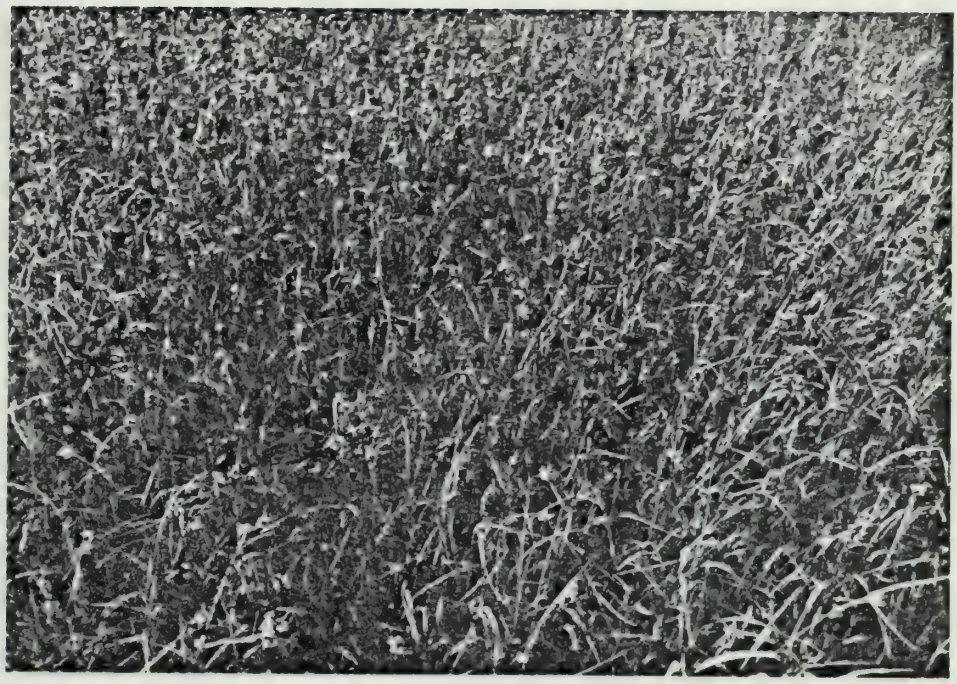

PLATE 12. SEDGES INHABIT MARSHY BORDER AREAS OF HARPER DRY LAKE.

PLATE 13. SALT DEPOSITS SURROUND THE SAMPLING SITE AT HARPER DRY LAKE.

PLATE 14. WATER SAMPLES WERE CAUTIOUSLY OBTAINED FROM A SHALLOW POOL AT HARPER DRY LAKE.

PLATE 15. HARPER DRY LAKE SURBER SAMPLES WERE PRESERVED AND SEALED AT THE SITE.

Table 2.1-1. PARAMETERS, UNITS, AND METHODS

TYPE OF INVESTIGATION	PARAMETER	UNITS	METHOD	REFERENCE
BIOLOGICAL	Benthic macroinvertebrates	fauna/ft^2	Surber sample	5,9,11
	Bacteria:			
	Total coliform	bacteria/100 ml	Membrane filtration	5,12,13
	Fecal coliform			
	Fecal streptococcus			
CHEMICAL: Field Analyses	Dissolved oxygen	mg/l	Azide modification	5,8
	pH		Meter	5,6
	Alkalinity as $CaCO_3$		Sulfuric acid titration	5
	Carbonate	mg/l	Calculation	5
	Bicarbonate	mg/l	Calculation	5
	Dissolved carbon dioxide	mg/l	Calculation	8
	Conductivity	µmho	Meter	5
CHEMICAL: Lab Analyses	Total hardness as $CaCO_3$	mg/l	Calculation from atomic absorption results for Ca^{++} and Mg^{++}	5
	Total calcium Ca^{++}	mg/l	Atomic absorption	5

Continued next page

Table 2.1-1 (Cont'd.). PARAMETERS, UNITS, AND METHODS

TYPE OF INVESTIGATION	PARAMETER	UNITS	METHOD	REFERENCE
CHEMICAL: Lab Analyses	Total magnesium Mg^{++}	mg/l	Atomic absorption	5
	Total dissolved solids	mg/l	Gravimetric	5,8
	Nitrate nitrogen as N	mg/l	Brucine	5
	Total filtrable ortho-phosphate $PO_4^{\equiv}$ as P	mg/l	Ascorbic acid	5
	Total filtrable ortho-phosphate $PO_4^{\equiv}$	mg/l	Ascorbic acid	5
	Chloride Cl^-	mg/l	Argentometric	5
	Fluoride F^-	mg/l	Specific ion electrometry	5
	Boron B	mg/l	Curcumin	5
	Sulfate $SO_4^{\equiv}$	mg/l	Turbidimetric	5
	Total iron Fe^{+++}	mg/l	Atomic absorption	5
	Total copper Cu^{++}	mg/l	Atomic absorption	5
	Total zinc Zn^{++}	mg/l	Atomic absorption	5
	Total potassium K^+	mg/l	Atomic absorption	5
	Total sodium Na^+	mg/l	Atomic absorption	5

Continued next page

Table 2.1-1 (Cont'd.) PARAMETERS, UNITS, AND METHODS

TYPE OF INVESTIGATION	PARAMETER	UNITS	METHOD	REFERENCE
CHEMICAL: Lab Analyses	Silicon Si	mg/l	Atomic absorption	5
	Silica SiO_2	mg/l	Atomic absorption	5
PHYSICAL	Air temperature	°C	Mercury thermometer	
	Water temperature	°C	Mercury thermometer	
	Flow	m^3/s	Current meter	7
	Suspended sediment	mg/l	Gravimetric	5
	Suspended sediment	mg/l/s	Equal transit rate	7
	Bed load	g/min	Helley-Smith	7
	Turbidity	NTU[1]	Nephelometric	5

[1] Nephelometric turbidity units.

Table 2.1-2. FIELD EQUIPMENT

TYPE OF INVESTIGATION	EQUIPMENT DESCRIPTION
BIOLOGICAL	Surber sampler
	Aluminum pan
	Forceps
	37% W/V formaldehyde
	Sample storage jars
	Biological labels
	Millipore filter holder assembly
	Millipore sterile petri dishes
	Millipore sterile absorbent pads
	Millipore smooth-tipped forceps
	Millipore HC filters
	Millipore MF-Endo medium (ampoules)
	Millipore M-FC medium (ampoules)
	Millipore KF Agar medium (dehydrated)
	1% W/V 2, 3, 5-triphenyltetrozolium chloride (TTC)
	Millipore ampoule breaker
	Millipore 1 ml sterile pipettes
	Absolute methanol
	Millipore Millex filter units
	Millipore 50 ml syringes
	Sterile phosphate buffer
	Millipore portable incubator

Continued next page

Table 2.1-2 (Cont'd.). FIELD EQUIPMENT

TYPE OF INVESTIGATION	EQUIPMENT DESCRIPTION
BIOLOGICAL	Millipore MF aluminum block incubator
	12 volt, 48 amp batteries (2)
	Battery charger
	Illuminating hand lens
CHEMICAL	Burettes
	Burette holder
	Burette stand
	Corning Model 610A Expandable Portable pH meter
	Corning pH probes
	Biochemical oxygen demand bottles
	Ehrlenmeyer flasks (250 ml and 500 ml)
	Graduated cylinders
	Funnels
	Volumetric pipettes
	Beakers
	Hach alkaline iodide-azide powder pillows
	Hach manganous sulfate powder pillows
	Concentrated sulfuric acid
	Standardized 0.1N sodium thiosulfate (preserved with chloroform)

Continued next page

Table 2.1-2 (Cont'd.). FIELD EQUIPMENT

TYPE OF INVESTIGATION	EQUIPMENT DESCRIPTION
CHEMICAL	Starch indicator solution
	Corning pH 4.01 and pH 7.00 buffer solutions
	Standardized 1.0N sulfuric acid
PHYSICAL	US DH[1]-48 sediment sampler
	US DH-59 sediment sampler
	Sediment sampler rods
	Sample bottles with caps
	Helley-Smith bed load sampler with bags
	US BMH[2]-53 bed material sampler
	Shovel
	Trowel
	Price flow meter
	Price Pygmy flow meter with rod, headset, and battery
	100 ft tapes
	Collapsible wooden ruler
	Stopwatch
	HF Instruments Model DRT-15 turbidimeter
	Yellowstone Scientific Instruments Model 33 S-C-T conductivity meter
	Surveying level, tripod, and rod

Table 2.1-2. FIELD EQUIPMENT

TYPE OF INVESTIGATION	EQUIPMENT DESCRIPTION
MISCELLANEOUS	Canon 35mm camera and kit
	Sledge hammer
	Orange-painted marker pipes
	Fire extinguisher
	Boots, waders, and flotation safety vests

[1]United States Depth Integrating Hand Held.
[2]United States Bed Material Hand Held.

Total coliform: 20 to 80 colonies per sample;

Fecal coliform: 20 to 60 colonies per sample; and

Fecal streptococcus: 20 to 100 colonies per sample.

Bacterial densities were calculated by the following formula:

$$\frac{\text{Number of colonies counted} \times 100}{\text{Sample size in milliliters}} = \text{Number of organisms per 100 milliliters of sample}$$

Fecal coliform-fecal streptococcus ratios were calculated to provide an indication of the most probable source of fecal contamination (12). Further discussion of the significance of indicator bacteria and of the fecal coliform-fecal streptococcus ratio is presented in Appendix C.

2.1.2 Chemical Parameters

2.1.2.1 *Field Procedures*

Dissolved oxygen (DO) was determined by the azide modification of the iodometric method. The sample was obtained from the main stream channel or central pool area and care was taken to avoid trapped air or agitation. Alkaline-azide and manganous sulfate reagents were added immediately to avoid the effects of temperature change, and the volume decanted for titration following sulfuric acid treatment was corrected for sample loss by displacement (5).

pH was measured with a Corning Model 610A expandable portable pH meter. To protect the instrument, samples were drawn and immediately measured *in vitro*. The instrument was calibrated before each use with Corning pH 7.00 prepackaged buffer solution, and 2 to 5 minutes were allowed for equilibration before the stabilized reading was recorded.

Alkalinity was determined by manual titration using the Corning Model 610A pH meter calibrated in the 4.0 to 8.5 pH range with Corning pH 4.01 and 7.00 prepackaged buffer solutions (5). The phenolphthalein alkalinity was determined,

where appropriate, by titration with standardized 0.02 N sulfuric acid to pH 8.3. Total alkalinity was measured by further titration to pH 4.5. Two to five minutes were allowed for electrode equilibration in each case. Calculations were as follows:

$$\text{Phenolphthalein alkalinity as milligrams of calcium carbonate per liter} = \frac{A \times N \times 50{,}000}{\text{milliliters of sample}}$$

$$\text{Total alkalinity as milligrams of calcium carbonate per liter} = \frac{B \times N \times 50{,}000}{\text{milliliters of sample}}$$

where A = milliliters of titrant required to reach pH 8.3
B = milliliters of titrant required to reach pH 4.5
C = normality of sulfuric acid titrant

Alkalinity relationships of hydroxide, carbonate, and bicarbonate were determined from a table of stoichiometric conversions (5).

Dissolved (free) carbon dioxide concentration was calculated from the previously determined bicarbonate concentration and sample pH using the following formula as derived using known stoichiometric relationships:

$$[CO_2] = \frac{0.88}{K_1} \; 10^{-pH} \; [HCO_3^-]$$

where,

$[CO_2]$ = concentration of carbon dioxide in milligrams per liter, as CO_2,

K_1 = ionization constant for carbonate in water (variable with temperature),

$[HCO_3^-]$ = concentration of bicarbonate in milligrams per liter, as $CaCO_3$.

This approach recognizes the dependency of free carbon dioxide upon water temperature. Its derivation is presented as Appendix D.

Conductivity was measured directly from the stream channel with a Yellow-stone Scientific Instruments Model 33 S-C-T conductivity meter and recorded as micromhos per centimeter.

2.1.2.2 *Laboratory Procedures*

Streamwater samples were collected in Nalgene polyethylene bottles, labeled, and immediately packed in ice within insulated ice chests. The samples were transported within 6 hours after collection to the Tetra Tech water quality laboratory at Pasadena, California, where they were analyzed immediately upon arrival, regardless of the hour of day or night.

The following water quality parameters were determined and expressed as milligrams per liter of sample:

Silica (SiO_2)
Silicon (Si)
Total iron as Fe^{+++}
Total copper as Cu^{++}
Total zinc as Zn^{++}
Total calcium as Ca^{++}
Total magnesium as Mg^{++}
Total sodium as Na^{+}
Total potassium as K^{+}
Sulfate ($SO_4^{=}$)
Chloride (Cl^{-})
Fluoride (F^{-})
Nitrate (NO_3^{-}) nitrogen as N
Total filterable orthophosphate as $PO_4^{\equiv}$
Total filterable orthophosphate ($PO_4^{\equiv}$) as phosphorus (P)
Boron as B
Total dissolved solids
Total hardness as calcium carbonate ($CaCO_3$)
Biochemical oxygen demand as O
Chemical oxygen demand as O

Samples to be analyzed for total hardness and metals were preserved upon collection with concentrated nitric acid (5 milliliters per liter of sample) (5). Samples analyzed for the remaining parameters were collected and cooled without preservative. Nitrate was the first parameter to be analyzed for every stream.

Major instruments used for the laboratory analyses were:

Atomic Absorption and Emission Spectrophotometer (Instrument Laboratory Model 253)

Carbon Rod Atomizer (Varian Model 63)

Ultraviolet-Visible-Infrared Spectrophotometer (Bausch and Lomb Spectronic 100)

Specific Ion Analyzer (Orion Model 470)

Support equipment included Millipore membrane filtration apparatus, drying ovens, an analytical balance, and chelating and digestion systems. Sample blanks and standards accompanied the sample unknowns in all test procedures. Quality control was maintained in conformance with established guidelines and the Tetra Tech quality assurance manual (5,6,8,14).

2.1.3 Physical Parameters

Air and water temperature, rate of flow, bottom material size composition, suspended sediment, and turbidity were determined by standard procedures (5, 7,9).

Flow measurements of the Mojave River were made at a straight portion of the stream with an even channel bottom. A tape was stretched across the stream and depth was measured at 18 increments. Flow was then measured at the same increments using a Price Pygmy meter. Discharge was later calculated and a drawing made of the channel cross-section at the measurement site.

Samples of representative sediment types were taken with a hand-held piston corer or trowel from the channel or pool, banks, and surrounding areas. These were labeled and later dried, sieved, weighed, and analyzed for size constituents in the Tetra Tech sediment laboratory.

A suspended sediment sample was collected at Afton Canyon with a US DH-48 sampler for equal transit rate (ETR) determination. The ETR sample was analyzed by a modification of the standard filtration technique (10).

Turbidity was measured directly with an HF Instruments DRT-15 turbidimeter following calibration with an HF Instruments reference standard.

Further details of the physical analyses conducted within this investigation are presented as Appendix E.

2.2 Results

The results of biological, chemical, and physical analyses are presented as follows:

- San Sebastian Marsh: Tables 2.2-1 through 2.2-4
- Harper Dry Lake Area: Tables 2.2-5 through 2.2-9
- Afton Canyon: Tables 2.2-10 through 2.2-14

These results are discussed in Section 2.3, Discussion.

2.3 Discussion

2.3.1 San Sebastian Marsh

2.3.1.1 *Biological Parameters*

The bed of San Felipe Creek consisted of homogeneous mud and was characterized by almost total absence of vascular and non-vascular plants at the time of the field visit on November 28, 1979.

Table 2.2-1. BACTERIOLOGICAL ANALYSES OF SAN FELIPE CREEK WATER SAMPLED WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1500 HOURS (3:00 PM)

PARAMETER	UNIT	QUANTITY
Total coliform (TC)	Bacteria/100 ml	2,700
Fecal coliform (FC)	Bacteria/100 ml	18
Fecal streptococcus (FS)	Bacteria/100 ml	181
FC/FS ratio		0.1
Probable fecal source[1]		livestock or wildlife

[1]Based on FC/FS ratio (Millipore Corporation, 1975).

Table 2.2-2. CHEMICAL ANALYSES OF SAN FELIPE CREEK WATER SAMPLED WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1500 HOURS (3:00 PM)

PARAMETER	UNITS	QUANTITY
Silica (SiO_2)	mg/l	10.3
Silicon (Si)	mg/l	4.8
Total iron as Fe^{++}	mg/l	0.30
Total copper as Cu^{++}	mg/l	0.02
Total zinc as Zn^{++}	mg/l	<0.001
Total calcium as Ca^{++}	mg/l	355
Total magnesium as Mg^{++}	mg/l	151
Total sodium as Na^{+}	mg/l	1,545
Total potassium as K^{+}	mg/l	28.0
Sulfate ($SO_4^{=}$)	mg/l	210
Chloride (Cl^{-})	mg/l	1,978
Fluoride (F^{-})	mg/l	0.74
Nitrate (NO_3^{-}) nitrogen as N	mg/l	0.07
Total filterable orthophosphate as $PO_4^{\equiv}$	mg/l	<0.03
Total filterable orthophosphate ($PO_4^{\equiv}$) as phosphorus (P)	mg/l	<0.01
Boron as B	mg/l	2.86
Total dissolved solids	mg/l	6,522
Total hardness as calcium carbonate ($CaCO_3$)	mg/l	1,508
Total alkalinity as calcium carbonate ($CaCO_3$)	mg/l	258
Carbonate alkalinity as $CaCO_3$	mg/l	0
Bicarbonate alkalinity as $CaCO_3$	mg/l	258
Dissolved carbon dioxide (CO_2)	mg/l	134.5
pH		6.7
Biochemical oxygen demand as O*	mg/l	<1
Chemical oxygen demand as O	mg/l	1.8
Dissolved oxygen (O_2)	mg/l	8.85

* 5-day

Table 2.2-3. PHYSICAL MEASUREMENTS OF SAN FELIPE CREEK MADE WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1530 HOURS (3:30 PM)

MEASUREMENT	UNIT	QUANTITY
Air temperature	°C	17.1
Water temperature	°C	15.2
Conductivity	µmho/cm	4,200
Salinity	ppt[1]	2.5
Turbidity	NTU[2]	36

[1]Parts per thousand.

[2]Nephelometric turbidity units.

Table 2.2-4. ANALYSES OF SAN FELIPE CREEK SEDIMENTS SAMPLED WITHIN THE SAN SEBASTIAN MARSH ON NOVEMBER 28, 1978 AT 1600 HOURS (4:00 PM)

SAMPLING LOCATION (*Directions are to the nearest cardinal point*)	TOTAL DRY MASS OF SAMPLE (g)	SIEVE CHARACTERISTICS			SAMPLE MASS RETAINED BY SIEVE (g)	PERCENT SAMPLE MASS RETAINED BY SIEVE	CUMULATIVE PERCENT SAMPLE MASS
		ϕ	mm	Mesh Number			
1. Base of bank wall 0.3 m south from south edge of stream	60.7	1.5	0.35	45	14.0	23.1	23.1
		2.0	0.25	60	6.5	10.7	33.8
		2.5	0.177	80	7.5	12.3	46.1
		3.0	0.125	120	13.4	22.1	68.2
		3.5	0.088	170	8.3	13.7	81.9
		4.0	0.0625	230	6.0	9.9	91.8
		Pan	<0.0625		5.0	8.2	100.0
2. Channel bottom 0.6 m north from south edge of stream	67.4	1.5	0.35	45	14.6	21.7	21.7
		2.0	0.25	60	4.8	7.1	28.8
		2.5	0.177	80	6.4	9.5	38.3
		3.0	0.125	120	16.3	24.2	62.5
		3.5	0.088	170	10.7	15.9	78.4
		4.0	0.0625	230	8.1	12.0	90.4
		Pan	<0.0625		6.5	9.6	100.0

Table 2.2-5. BENTHIC INVERTEBRATE FAUNA OF A POOL WITHIN THE HARPER DRY LAKE AREA SAMPLED ON NOVEMBER 29, 1978 AT 1415 HOURS (2:15 PM)

PHYLUM	CLASS	ORDER	QUANTITY (ORGANISMS/FT^2)**	FAMILIES PRESENT
Arthropoda	Insecta	Coleoptera	14	Dytiscidae Hydraenidae[1] Hydrophilidae[2]
		Diptera	786	Culicidae[3] Dolichopodidae Ephydridae Tendipedidae[2,4,5]
		Hemiptera	4	Corixidae Hebridae[2,6]
		Odonata	158	*
		Trichoptera	4	*

*Not determined.
**1 square foot = 929 square centimeters.

[1]Probable identification.

[2]Numerically predominant taxon.

[3]Subfamily Culicinae.

[4]Chaoboridae.

[5]Probably subfamilies Hydrobaeninae and Tendipedinae.

[6]*Merragata hebroides* adults.

Table 2.2-6. BACTERIOLOGICAL ANALYSES OF HARPER DRY LAKE AREA WATER SAMPLED ON NOVEMBER 29, 1978 AT 1230 HOURS (12:30 PM)

PARAMETER	UNIT	QUANTITY
Tocal coliform (TC)	Bacteria/100 ml	270,000
Fecal coliform (FC)	Bacteria/100 ml	36
Fecal streptococcus (FS)	Bacteria/100 ml	2,750
FC/FS ratio		0.01
Probable fecal source[1]		livestock or wildlife

[1]Based on FC/FS ratio (Millipore Corporation, 1975).

Table 2.2-7. CHEMICAL ANALYSES OF HARPER DRY LAKE AREA WATER SAMPLED ON NOVEMBER 29, 1978 AT 1230 HOURS (12:30 PM)

PARAMETER	UNITS	QUANTITY
Silica (SiO_2)	mg/l	47.4
Silicon (Si)	mg/l	22.2
Total iron as Fe^{+++}	mg/l	20.5
Total copper as Cu^{++}	mg/l	0.05
Total zinc as Zn^{++}	mg/l	0.010
Total calcium as Ca^{++}	mg/l	3,660
Total magnesium as Mg^{++}	mg/l	116
Total sodium as Na^{+}	mg/l	3,195
Total potassium as K^{+}	mg/l	52.0
Sulfate ($SO_4^{=}$)	mg/l	220
Chloride (Cl^{-})	mg/l	4,515
Fluoride (F^{-})	mg/l	1.42
Nitrate (NO_3^{-}) nitrogen as N	mg/l	0.08
Total filterable orthophosphate as $PO_4^{\equiv}$	mg/l	<0.003
Total filterable orthophosphate ($PO_4^{\equiv}$) as phosphorus (P)	mg/l	<0.001
Boron as B	mg/l	9.70
Total dissolved solids	mg/l	11,222
Total hardness as calcium carbonate ($CaCO_3$)	mg/l	9,618
Total alkalinity as calcium carbonate ($CaCO_3$)	mg/l	236
Carbonate alkalinity as $CaCO_3$	mg/l	0
Bicarbonate alkalinity as $CaCO_3$	mg/l	236
Dissolved (free) carbon dioxide (CO_2)	mg/l	9.4
pH	----	7.8
Biochemical oxygen demand as O *	mg/l	8.6
Chemical oxygen demand as O	mg/l	98
Dissolved oxygen (O_2)	mg/l	8.35

* 5-day

Table 2.2-8. PHYSICAL MEASUREMENTS OF HARPER DRY LAKE AREA WATER MADE ON NOVEMBER 29, 1978 AT 1330 HOURS (1:30 PM)

MEASUREMENT	UNIT	QUANTITY
Air temperature	°C	18.2
Water temperature	°C	20.6
Conductivity	µmho/cm	13,600
Salinity	ppt[1]	9.0
Turbidity	NTU[2]	16

[1]Parts per thousand.

[2]Nephelometric turbidity units.

Table 2.2-9. ANALYSES OF SEDIMENTS OBTAINED FROM MARSHY PORTIONS OF THE HARPER DRY LAKE AREA ON NOVEMBER 29, 1978 AT 1415 HOUR (2:15 PM)

SAMPLING LOCATION (*Directions are to the nearest cardinal point*)	TOTAL DRY MASS OF SAMPLE (g)	SIEVE CHARACTERISTICS			SAMPLE MASS RETAINED BY SIEVE (g)	PERCENT SAMPLE MASS RETAINED BY SIEVE	CUMULATIVE PERCENT SAMPLE MASS
		ϕ	mm	Mesh Number			
1. Moist substrate 1.5 m south from edge of pool used for water sampling	82.3	0.5	0.71	25	17.6	21.4	21.4
		1.0	0.50	35	17.8	21.6	43.0
		1.5	0.35	45	4.7	5.7	48.7
		2.0	0.25	60	7.6	9.2	57.9
		2.5	0.177	80	7.7	9.4	67.3
		3.0	0.125	120	10.2	12.4	79.7
		Pan	<0.125		16.7	20.3	100.0
2. Approximate center of pool used for water sampling, 1.5 m north from south edge	61.9	0.5	0.71	25	10.4	16.8	16.8
		1.0	0.5	35	14.3	23.1	39.9
		1.5	0.35	45	4.8	7.7	47.6
		2.0	0.25	60	7.2	11.6	59.2
		2.5	0.177	80	8.9	14.4	73.6
		3.0	0.125	120	10.0	16.2	89.8
		Pan	<0.125		6.3	10.2	100.0

Table 2.2-10. BENTHIC INVERTEBRATE FAUNA OF THE MOJAVE RIVER SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1630 HOURS (4:30 PM)

PHYLUM	CLASS	ORDER	QUANTITY (ORGANISMS/FT^2)**	FAMILIES PRESENT
Annelida	Oligochaeta	*	24	*
Arthropoda	Crustacea	Copepoda	8	*
		Ostracoda	>1,000	*
	Insecta	Coleoptera	12	Hydrophilidae
		Diptera	937	Stratiomyidae
				Tendipedidae[1,2]
		Ephemeroptera	226	*
		Odonata	248	*
		Trichoptera	305	*
Mollusca	Gastropoda	*	28	*

*Not determined.

**1 square foot = 929 square centimeters.

[1]Chaoboridae.

[2]Numerically predominant taxon.

Table 2.2-11. BACTERIOLOGICAL ANALYSES OF MOJAVE RIVER WATER SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1530 HOURS (3:30 PM)

PARAMETER	UNIT	QUANTITY
Total coliform (TC)	Bacteria/100 ml	48,700
Fecal coliform (FC)	Bacteria/100 ml	16
Fecal streptococcus (FS)	Bacteria/100 ml	144
FC/FS ratio		0.1
Probable fecal source[1]		livestock or wildlife

[1]Based on FC/FS ratio (Millipore Corporation, 1975).

Table 2.2-12. CHEMICAL ANALYSES OF MOJAVE RIVER WATER SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1530 HOURS (3:30 PM)

PARAMETER	UNITS	QUANTITY
Silica (SiO_2)	mg/l	19.5
Silicon (Si)	mg/l	9.1
Total iron as Fe^{+++}	mg/l	0.03
Total copper as Cu^{++}	mg/l	0.01
Total zinc as Zn^{++}	mg/l	<0.001
Total calcium as Ca^{++}	mg/l	11.0
Total magnesium as Mg^{++}	mg/l	2.0
Total sodium as Na^{+}	mg/l	252
Total potassium as K^{+}	mg/l	6.2
Sulfate ($SO_4^{=}$)	mg/l	22
Chloride (Cl^{-})	mg/l	151
Fluoride (F^{-})	mg/l	4.36
Nitrate (NO_3^{-}) nitrogen as N	mg/l	0.04
Total filterable orthophosphate as $PO_4^{\equiv}$	mg/l	<0.03
Total filterable orthophosphate ($PO_4^{\equiv}$) as phosphorus (P)	mg/l	<0.01
Boron as B	mg/l	2.30
Total dissolved solics	mg/l	907
Total hardness as calcium carbonate ($CaCO_3$)	mg/l	35.8
Total alkalinity as calcium carbonate ($CaCO_3$)	mg/l	316
Carbonate alkalinity as $CaCO_3$	mg/l	0
Bicarbonate alkalinity as $CaCO_3$	mg/l	316
Dissolved (free) carbon dioxide (CO_2)	mg/l	25.6
pH	----	7.5
Biochemical oxygen demand as O*	mg/l	<1
Chemical oxygen demand as O	mg/l	9.5
Dissolved oxygen (O_2)	mg/l	8.70

* 5-day

Table 2.2-13. PHYSICAL MEASUREMENTS OF THE MOJAVE RIVER AT AFTON CANYON ON DECEMBER 6, 1978 AT 1600 HOURS (4:00 PM)

MEASUREMENT	UNIT	QUANTITY
Air temperature	°C	6.8
Water temperature	°C	11.5
Conductivity	µmho/cm	890
Salinity	ppt[1]	0.6
Turbidity	NTU[2]	2.4
Suspended sediment[3]	g/l/s	3.11×10^{-4}
Flow	m^3/s	0.03[4]

[1]Parts per thousand.

[2]Nephelometric turbidity units.

[3]Equal transit rate at t=40 s.

[4]1.09 cfs

Table 2.2-14. ANALYSES OF MOJAVE RIVER SEDIMENTS SAMPLED AT AFTON CANYON ON DECEMBER 6, 1978 AT 1630 HOURS (4:30 PM)

SAMPLING LOCATION (*Directions are to the nearest cardinal point*)	TOTAL DRY MASS OF SAMPLE (g)	SIEVE CHARACTERISTICS			SAMPLE MASS RETAINED BY SIEVE (g)	PERCENT SAMPLE MASS RETAINED BY SIEVE	CUMULATIVE PERCENT SAMPLE MASS
		ϕ	mm	Mesh Number			
1. Bank 0.3 m south from south edge of stream	78.3	1.5	0.35	45	9.4	12.0	12.0
		2.0	0.25	60	8.0	10.2	22.2
		2.5	0.177	80	14.2	18.1	40.3
		3.0	0.025	120	20.6	26.3	66.6
		3.5	0.088	170	11.0	14.1	80.7
		4.0	0.0625	230	8.8	11.2	91.9
		Pan	<0.0625		6.3	8.1	100.0
2. Channel bottom 2.7 m north from south edge of stream along cross section	70.6	-2.0	4.0	5	20.6	29.2	29.2
		-1.5	2.83	7	2.3	3.2	32.4
		-1.0	2.0	10	2.5	3.5	35.9
		-0.5	1.41	14	2.4	3.4	39.3
		0.0	1.0	18	3.3	4.7	44.0
		0.5	0.71	25	5.5	7.8	51.8
		Pan	<0.71		34.0	48.2	100.0
3. Channel bottom 4.0 m north from south edge of stream along cross section	88.3	-1.0	2.0	10	14.5	16.4	16.4
		-0.5	1.41	14	5.3	6.0	22.4
		0.0	1.0	18	6.7	7.6	30.0
		0.5	0.71	25	10.4	11.8	41.8
		1.0	0.5	35	21.5	24.4	66.2
		1.5	0.35	45	6.9	7.8	74.0
		Pan	<0.35		23.0	26.0	100.0
4. Channel bottom 4.9 m north from south edge of stream along cross section	140.8	-2.0	4.0	5	57.9	41.1	41.1
		-1.5	2.83	7	12.4	8.8	49.9
		-1.0	2.0	10	12.2	8.7	58.6
		-0.5	1.41	14	12.7	9.0	67.6
		0.0	1.0	18	11.6	8.3	75.9
		0.5	0.71	25	12.7	9.0	84.9
		Pan	<0.71		21.3	15.1	100.0
5. Bank 0.3 m north from north edge of stream	116.6	-2.0	4.0	5	37.5	32.2	32.2
		-1.5	2.83	7	6.3	5.4	37.6
		-1.0	2.0	10	7.7	6.6	44.2
		-0.5	1.41	14	8.6	7.4	51.6
		0.0	1.0	18	9.1	7.8	59.4
		0.5	0.71	25	11.9	10.2	69.6
		Pan	<0.71		35.5	30.4	100.0

At attempt was made to obtain a Surber sample so that a quantitative assessment of benthic invertebrate fauna inhabiting the muddy substrate could be made. However, the depth and softness of the mud prevented quantitative sampling because of substrate movement and precarious access. Non-quantitative samples obtained with the Surber sampler were subsequently analyzed; these revealed a total absence of all non-microscopic invertebrate animal life, including the tubificid worms and tendipedid fly larvae which one might expect to find inhabiting a muddy, sluggish stream with little vegetative cover. This result is suprising, because fish were observed in the creek at the time of sampling; these were reported potentially to include the desert pupfish (*Cyprinodon macularius*), the mosquitofish (*Gambusia affinis*), and the sailfin molly (*Poecilia latipinna*) (3). Moreover, normal quantities of bacteria were present, as shown in Table 2.2-1.

Although the fish species noted above are tolerant of high salinity (15), this factor is almost certainly not responsible for the absence of other macrofauna in San Felipe Creek; salinity was only 2.5 parts per thousand, well below the 9.0 parts per thousand of the Harper Dry Lake study area, which supported a rich benthic faunal community and abundant vegetation (see Tables 2.2-3, 2.2-5, and 2.2-8). The low chemical and biochemical oxygen demand levels of San Felipe Creek are consistent with a low availability of organic nutrients, but other water quality parameters shown in Table 2.2-2 appear to be within normal plant and animal tolerance ranges, and the presence of bacteria and fish probably eliminates the possibility of agricultural or other toxic contaminants as an explanation for the lack of aquatic vegetation and benthic fauna. Clearly, further investigation is required to confirm and explain the paucity of aquatic plants and invertebrate animals suggested by this spot-check of San Felipe Creek. A more thorough study specifically directed towards benthic fauna will almost certainly reveal the presence of oligochaetes and larval insects, among other groups.

On the basis of the present limited observations, it seems probable that flow and substrate characteristics are primarily responsible for the apparent lack of plant and invertebrate animal life within San Felipe Creek. The microhabitats which are necessary to provide niches for the establishment

of a stable benthic ecosystem within a streambed require at least some degree of substrate structural integrity. In the case of San Felipe Creek, large seasonal flow variation and heavy silt deposition from tributary rainfall runoff may prevent the substrate stability necessary for the consistent support of rooted aquatic vegetation and an associated benthic animal community.

Bacterial concentrations of San Felipe Creek, shown in Table 2.2-1, were all within ranges consistent with unpolluted, untreated surface water (12). The fecal coliform to fecal streptococcus ratio (FC/FS) indicates that the probable source of fecal contamination is livestock or wildlife, a finding consistent with existing land uses and the remoteness of the study area from human activity (12).

2.3.1.2 *Chemical Parameters*

Chemical constituents of San Felipe Creek, shown in Table 2.2-2, appear to be consistent with location, climate, and soil characteristics. Large concentrations of calcium, magnesium, sodium, potassium, sulfate, chloride, and boron probably reflect the evaporative concentration of these ions by the hot, dry climate of the study area. High total dissolved solids, total hardness as calcium carbonate, and bicarbonate alkalinity as calcium carbonate probably indicate the combined influences of evaporative salt loading and erosion of the surrounding soils by rainfall runoff.

The high concentration of dissolved carbon dioxide is based on a dependably recorded and double-checked pH of 6.7; it may reflect the almost total absence of vegetation within San Felipe Creek. Green plants would metabolize dissolved carbon dioxide during photosynthesis, thereby reducing its concentration in surrounding water. The carbon dioxide concentration may also reflect bicarbonate charging of the springs feeding the creek; in this case, dissolved carbon dioxide levels might be expected to decline as a function of distance from the springs, and the recorded concentration would not reflect an equilibrium condition.

Biochemical and chemical oxygen demands were very low, indicating correspondingly low levels of organic nutrients in the sample, a finding consistent with the generally observed lack of plant and animal life within the creek.

Specific chemical water quality objectives have been established as limiting conditions for certain physical characteristics and constituents of surface waters within the West Colorado River Basin by the State Water Resources Control Board and the California Regional Water Quality Control Board, Colorado River Basin Region (16). These objectives are presented in Appendix G and discussed with respect to the water quality of San Felipe Creek in Section 4.1.2. Suspended material, settleable material, turbidity, boron concentration, and the total dissolved solids concentration exceed the established limits, whereas concentrations of bacteria, dissolved oxygen, total phosphate (orthophosphate), nitrate nitrogen, copper, and zinc meet the standards.

2.3.1.3 *Physical Parameters*

Conductivity, salinity, and turbidity values, reported in Table 2.2-3, are all high. They probably reflect large-scale evaporation and erosion, conditions consistent with the arid climate, fine soil, and turbid, muddy waters of the area.

At the sampling point, the banks of San Felipe Creek were about 3 meters (10 feet) high, bordering wide stretches of soft, deep mud. These conditions restricted access and prevented the establishment of a transect. Consequently, flow, bed load, and quantitative suspended sediment determinations were prevented. Two bottom material samples were obtained, however, and the results of their analyses are presented in Table 2.2-4. These results indicate that sediment grain sizes range from medium sand (0.35 millimeter) through coarse silt (less than 0.0625 millimeter), with consistent peaks in the percent sample mass retained by the sieves at the medium sand (0.35 millimeter) and very fine sand (0.125 millimeter) levels on the Wentworth Scale (17). These results are entirely consistent with visual and tactile inspections of the substrate at the sampling site.

2.3.2 Harper Dry Lake Area

2.3.2.1 *Biological Parameters*

Table 2.2-5 presents a quantitative analysis of one Surber sample made at the Harper Dry Lake area on November 29, 1978. At the time of sampling, the benthic population was low in diversity and consisted primarily of larval flies (Diptera) belonging to families known to be tolerant to higher saline levels than those typically associated with fresh water. These fly larvae comprised 81.4 percent of the total number of organisms in the sample, the majority belonging to the family Tendipedidae (Chaoboridae). Tendipedid larvae are of major importance as a food source for bottom-feeding shorebirds and waterfowl, and their presence in large numbers must be a significant factor in any assessment of the sampling area's potential for supporting wildlife, especially birds, on a regional basis (18). Other Dipteran larvae included the families Culicidae (mosquito larvae), Dolichopodidae, and Ephydridae (brineflies), the latter indicating the chronic high salinity of the area's surface water and known to be "especially prominent around inland salt and alkaline ponds" (18).

The data show a large step between the Diptera and the next most numerous order, the Odonata (dragonflies and damselflies), which comprised 16.4 percent of the total number of organisms in the sample. Coleoptera (beetles) made up only 1.5 percent of the total sample; all were adults belonging to the families Dytiscidae (predaceous water beetles), Hydraenidae (a probable but uncertain identification), and Hydrophilidae (water scavenger beetles), which are "commonest in marshy places, in weedy, shallow ponds, or in flooded areas where there is grass growing out of the water," and some species of which "prefer saline or mineralized waters" (19). Only two other insect orders were present in the Surber sample, Trichoptera (four larval caddisflies) and Hemiptera (true bugs). The four Hemiptera included one adult water boatman (Corixidae); this family is fully aquatic in all life stages and indicates that the presence of water in the sampling area may be permanent. The three remaining Hemiptera were adult *Merragata hebroides*, a species of velvet water bug (Hebridae) which inhabits floating plants, especially mats of filamentous

green algae such as those observed at the sampling site (20). Although this species cannot be described as benthic, its presence indicates that floating algae are commonly present within the pools of the Harper Dry Lake area.

Bacterial concentrations of the sampled pool, shown in Table 2.2-6, were consistent with conditions observed there. The high total coliform count, indicative of polluted, untreated surface water, reflects the combined influences of an organically rich substrate and frequent visits by birds and mammals. Concentrations of fecal coliform and fecal streptococcus bacteria are consistent with contamination by livestock or wildlife; the FC/FS ratio supports this conclusion (12).

2.3.2.2 *Chemical Parameters*

Chemical constituents of the Harper Dry Lake area water samples are shown in Table 2.2-7. Specific chemical water quality objectives have not been established for the area (21). Significantly high concentrations of silica and silicon probably reflect the sandy substrate. Iron as ferric ion, also present in a large concentration, may indicate ferric hydroxide precipitation; boggy or marshy areas containing large amounts of organic materials create reducing conditions in subsoil waters. Ferric iron is reduced and enters solution as ferrous bicarbonate, and subsequent oxidation following circulation and atmospheric contact may cause deposition of ferric hydroxide as a brown film; such a film was evident within the sampling pool and may have become suspended in the water sample during collection (20). Large concentrations of calcium, magnesium, sodium, potassium, sulfate, chloride, and boron, along with high levels of total dissolved solids and total water hardness as calcium carbonate, all indicate evaporative loading and are consistent with the physical properties of the sampling area: pools of irrigation water which collects in a relatively flat area, evaporates, and is replenished by continuing irrigation runoff. Biochemical and chemical oxygen demands are high, indicating significant levels of organic compounds; inspection of the pool during the field visit indicated large amounts of vegetative detritus. The dissolved oxygen content is within the range required to support a healthy plant and animal community (5).

2.3.2.3 *Physical Parameters*

Physical measurements of the Harper Dry Lake sampling pool are shown in Table 2.2-8. Conductivity, salinity, and turbidity are as expected for a shallow pool undergoing rapid evaporation and consequent salt loading, with a soft, sandy to muddy substrate covered by a layer of decaying vegetation and other detritus.

The results of sediment analyses are shown in Table 2.2-9. These indicate that grain sizes range from coarse sand (0.71 millimeter) through very fine sand (0.125 millimeter) as defined by the Wentworth Size Classification System (17).

2.3.3 Afton Canyon

2.3.3.1 *Biological Parameters*

Table 2.2-10 presents a quantitative analysis of one Surber sample of the Mojave River made at Afton Canyon on December 6, 1978. The depth, flow, and substrate of the stream were ideal for Surber sample application. The results show that at the site and time of sampling, the Mojave River supported a rich and diverse benthic community including annelid, arthropod, and molluscan taxa. This diversity is indicative and typical of streams characterized by superior water quality; pollution-free water allows the development of a complex ecosystem with many different kinds of animals interdependent through an intricate food chain, and with no single kind of animal predominating in number. In contrast, polluted waters allow only those organisms which are able to live in the presence of the contaminants or to tolerate the lack or over-abundance of a normally occurring constituent. Such water tends to support a few predominant groups with low species diversity, as appears to be the case with San Felipe Creek and the Harper Dry Lake sampling pool. At Afton Canyon, each identified taxon was represented by a variety of families, none of which was a known indicator of abnormal or extreme water quality conditions. Of the total number of organisms present in the sample, fly larvae (Diptera) comprised 52.4 percent, caddisfly larvae (Trichoptera) 17.1 percent, dragonfly and damselfly nymphs (Odonata) 13.9 percent, mayfly nymphs (Ephemeroptera) 12.6 percent, freshwater snails (Gastropoda) 1.6 percent, freshwater

annelid worms (Oligochaeta) 1.3 percent, adult and larval beetles (Coleoptera) 0.7 percent, and copepods (Copepoda) 0.5 percent. The many ostracods (Ostracoda) present are not included in this summary. The results clearly indicate a healthy benthic community.

The bacteriological analyses presented in Table 2.2-11 indicate an unexpectedly high total coliform count--one within the established range for polluted, untreated surface water (12). This result, based on three separate filtrations of a single carefully collected sample, may be artifactitious but is probably valid. Streams as clear as the Mojave River at Afton Canyon usually have much lower total coliform concentrations; high concentrations tend to be associated with turbidity and reflect bacteria present in eroded soil, if no obvious source of fecal contamination is present. A more thorough study is required to establish existing total coliform levels at selected sampling sites along the Mojave River. This is especially true in light of the low fecal coliform and fecal streptococcus levels recorded, both well within the established ranges for unpolluted, untreated surface water. The FC/FS ratio indicates that the very slight fecal contamination present in the sample was caused by livestock or wildlife (12).

2.3.3.2 *Chemical Parameters*

Chemical constituents of Mojave River water samples collected at Afton Canyon are shown in Table 2.2-12. Specific chemical water quality objectives for the Mojave River at Victorville have been established for five constituents (21). These compare with the recorded values at Afton Canyon as follows:

Constituent	Mean Objective (mg/l)	Recorded Value (mg/l)
• Total dissolved solids	300	907
• Chloride	75	151
• Sulfate	40	22
• Fluoride	0.2	4.36
• Boron	0.2	2.30

With the exception of values for total dissolved solids, chloride, fluoride, and boron, the results indicate that the chemical water quality of the Mojave River at Afton Canyon is excellent and meets all of the general water quality objectives established within the State Water Resources Control Board Water Quality Control Plan for the South Lahontan Basin (21).

2.3.3.3 *Physical Parameters*

Table 2.2-13 presents physical measurements of the Mojave River at Afton Canyon. All values indicate good water quality and are consistent with the general objectives for surface water quality for the South Lahontan Basin, where established (21). Conductivity, salinity, turbidity, and suspended sediment are all within ranges generally recommended for potable water (5).

As shown in Table 2.2-14, the range of sediment grain sizes varies with specific sampling location at Afton Canyon. For the five locations specified, the grain size distribution ranges from pebble (4 millimeters) to coarse silt (0.0625 millimeter), as defined by the Wentworth Size Classification System (17).

3.0 LAND USE AND WATER RIGHTS

3.1 Existing Land Use and Ownership Status

3.1.1 San Sebastian Marsh

The ownership status of the San Sebastian Marsh study area is shown in Figure 6. Sections alternate in a checkerboard pattern of public and private ownership, and there are no significant subdivisions. Table 3.1-1 provides an overview of existing land use and ownership for the sections shown in Figure 6.

All of the land within the San Sebastian Marsh study area is designated as "desert; vacant" by the Imperial County Assessor's Office. Sections 18, 22, 24, 26, 28, and 32 are federally owned and under the jurisdiction and management of BLM. These sections partially comprise the San Sebastian Natural Area; as shown in Plate 1, this area is closed to all vehicle use, although hiking and outdoor activities relating to natural history are allowed there (3).

3.1.2 Harper Dry Lake Area

Figure 7 shows the ownership status of the Harper Dry Lake study area. Sections 20, 21, 28, and 29 have been subdivided and are mostly privately owned. Land ownership and use for all of the parcels within these sections are presented in Table 3.1-2.

Privately owned land within the Harper Dry Lake study area is zoned for 20 to 40 acres minimum parcel size, in keeping with the established policy of the County of San Bernardino to maintain the area in agricultural, non-residential useage (22,23).

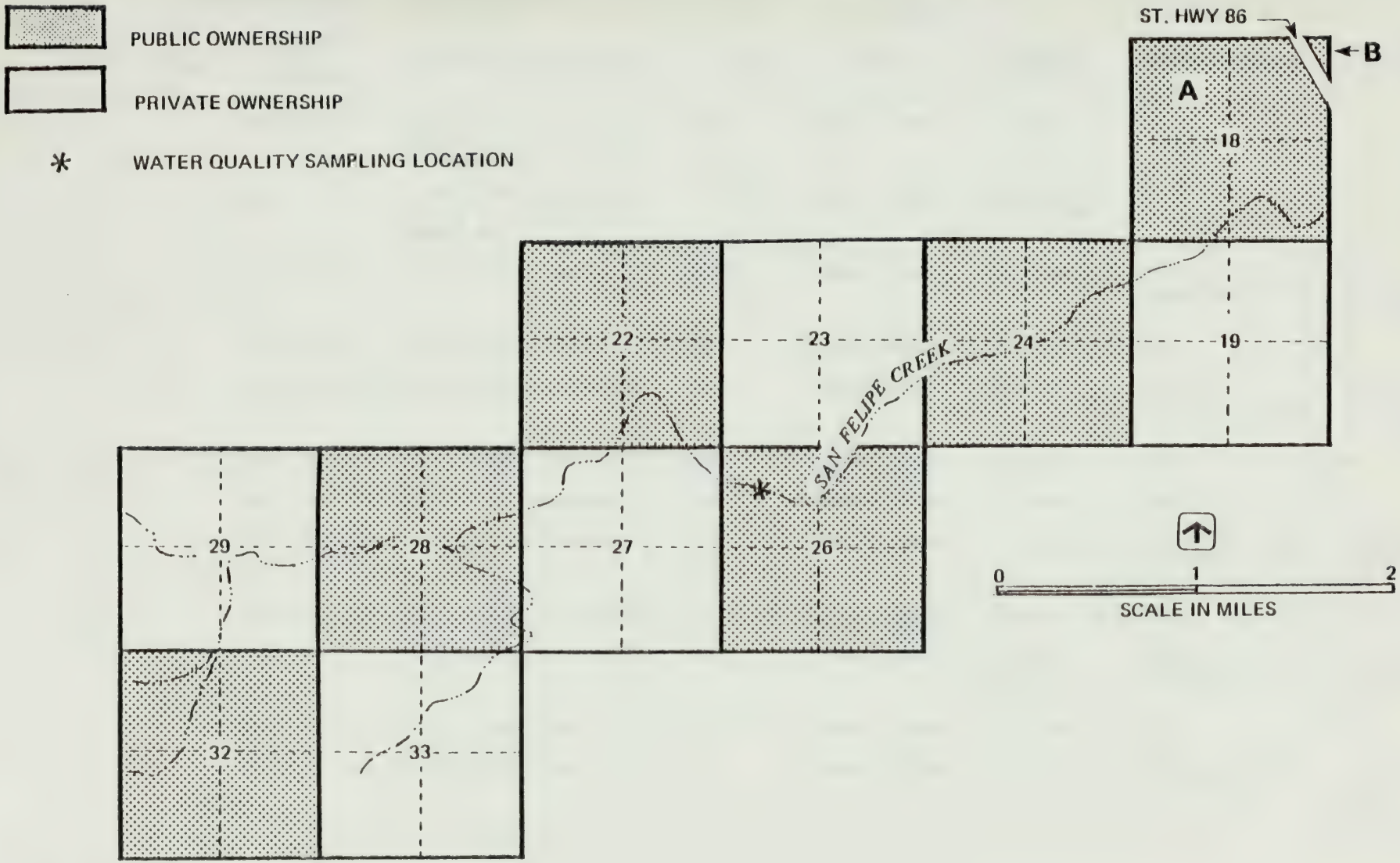

FIGURE 6: OWNERSHIP STATUS OF THE SAN SEBASTIAN MARSH STUDY AREA. PARCEL LETTERS REFER TO TABLE 3.1-1.

Table 3.1-1. LAND OWNERSHIP AND USE WITHIN THE SAN SEBASTIAN MARSH STUDY AREA

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
18	A	019 - 050 - 01	T.12S.,R.11E.; Section 18; except NE ¼ of NE ¼ lying W of Highway 86	636.49	Desert; vacant	On creek	USA	NL
18	B	019 - 050 - 02	T.12S.,R.11E.; Section 18, NE ¼ of NE ¼ lying E of Highway 86	3.11 M/L	Desert; vacant	Adjacent to Highway 86	USA	NL
19	-	019 - 050 - 13	T.12S.,R.11E.; Section 19	653.34	Desert; vacant	On creek	Hornby Corporation *et al.*	P.O. Box 1707 Palm Desert, CA 92260
22	-	018 - 180 - 03	T.12S.,R.10E.; Section 22	640	Desert; vacant	On creek	USA	NL
23	-	018 - 180 - 04	T.12S.,R.10E.; Section 23	640	Desert; vacant	On creek	Hornby Corporation *et al.*	P.O. Box 1707 Palm Desert, CA 92260
24	-	018 - 180 - 05	T.12S.,R.10E.; Section 24	640	Desert; vacant	On creek	USA	NL
26	-	018 - 180 - 07	T.12S.,R.10E.; Section 26	640	Desert; vacant	On creek	USA	NL
27	-	018 - 180 - 08	T.12S.,R.10E.; Section 27	640	Desert; vacant	On creek	Hornby Corporation *et al.*	P.O. Box 1707 Palm Desert, CA 92260
28	-	018 - 180 - 09	T.12S.,R.10E.; Section 28	640	Desert; vacant	On creek	USA	NL
29	-	018 - 180 - 10	T.12S.,R.10E.; Section 29	640	Desert; vacant	Spring located here	Hornby Corporation *et al.*	P.O. Box 1707 Palm Desert, CA 92260
32	-	018 - 180 - 13	T.12S.,R.10E.; Section 32	640	Desert; vacant	On creek	USA	NL
33	-	018 - 180 - 14	T.12S.,R.10E.; Section 33	640	Desert; vacant	On creek	Southern Pacific Land Company	One Market St. Room 942 San Francisco, CA 94105

[1]Parcel letters refer to Figure 6.
ML= More or less
NL= Information not listed

Source: Assessor's Office; Imperial County, California; 1978.

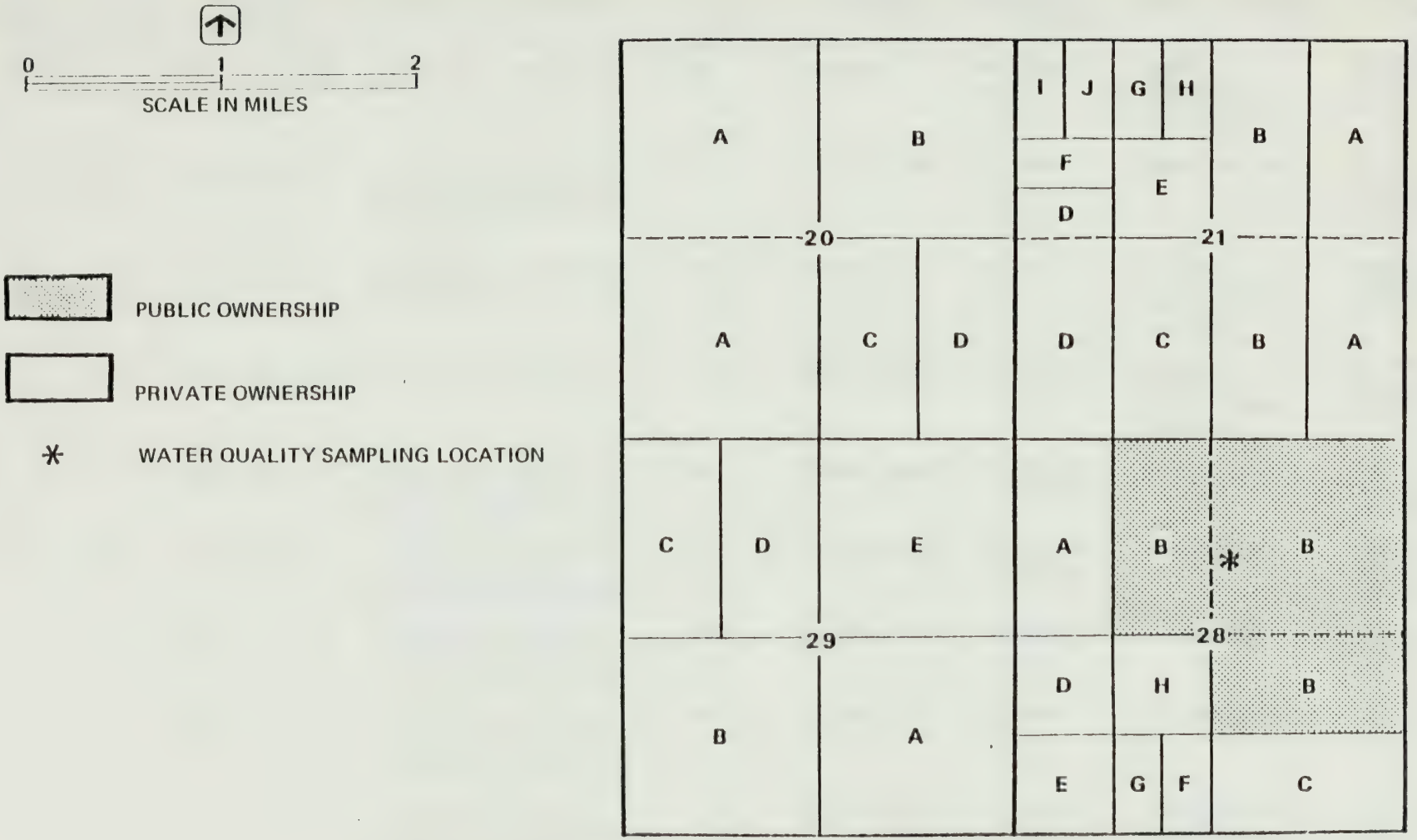

FIGURE 7: OWNERSHIP STATUS OF THE HARPER DRY LAKE STUDY AREA. PARCEL LETTERS REFER TO TABLE 3.1–2

Table 3.1-2. LAND OWNERSHIP AND USE WITHIN THE HARPER DRY LAKE STUDY AREA

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
20	A	490 - 091 - 09	T.11N.,R.4W.; Section 20; W½	320	Residence	Adjacent to marsh	Croddy, Schawwecker, Croddy, Croddy, and Walton	Box 4007 Santa Ana, CA 92702
20	B	490 - 091 - 10	T.11N.,R.4W.; Section 20; NE¼; except mineral rights as reserved by USA	160	Desert; vacant	On marsh	Pepperdine Univ.	c/o P.L. Harris, Vice President for Financial Planning Malibu, CA 90265
20	C	490 - 091 - 19	T.11N.,R.4W.; Section 20; W½ of SE¼	80	Desert; vacant	On marsh	Croddy, Schawwecker, Croddy, Croddy, and Walton	Box 4007 Santa Ana, CA 92702
20	D	490 - 091 - 20	T.11N.,R.4W; Section 20; E½ of SE¼	80	Desert; vacant	On marsh	Croddy, Schawwecker, Croddy, Croddy, and Walton	Box 4007 Santa Ana, Ca 92702
21	A	490 - 091 - 03	T.11N.,R.4W.; Section 21, E½ of E½; except 50% interest in mineral rights	160	Desert; vacant	On dry lake, near marsh	S. Hamburger	585 Mission St. San Francisco, CA 94105
21	B	490 - 091 - 04	T.11N.,R.4W.; Section 21; W½ of E½; except 50% interest in mineral rights	160	Desert; vacant	On dry lake, and marsh	S. Hamburger	585 Mission St. San Francisco, CA 94105
21	C	490 - 091 - 05	T.11N.,R.4W.; Section 21; E½ of SW¼; except 50% interest in mineral rights	80	Desert; vacant	On marsh	S. Hamburger	585 Mission St. San Francisco, CA 94105
21	D	490 - 091 - 07	T.11N.,R.4W.; Section 21; W½ of SW¼ and S½ of SW¼ of NW¼; except 50% interest in mineral rights	100	Desert; vacant	On marsh	S. Hamburger	585 Mission St. San Francisco, CA 94105
21	E	490 - 091 - 13	T.11N.,R.4W.; Section 21; SE¼ of NW¼ ; except mineral rights reservation of record	40	Desert; vacant	On marsh	Wholesale land Associates	39 S. La Salle St. Room 520, Chicago, IL 60603

Continued next page

Table 3.1-2 (Cont'd.). LAND OWNERSHIP AND USE WITHIN THE HARPER DRY LAKE STUDY AREA

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAMES(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
21	F	490 - 091 - 14	T.11N.,R.4W.; Section 21; N½ of SW¼ of NW¼; except mineral rights reservation of record	20	Desert; vacant	On dry lake, adjacent to marsh	Atkinson Corporation	39 S. La Salle St. Chicago, IL 60603
21	G	490 - 091 - 15	T.11N.,R.4W.; Section 21; W½ of NE¼ of NW¼; except mineral rights reservation of record	20 M/L	Desert; vacant	On dry lake, near marsh	T.E. Maeder and F.J. Maeder	1604 Bardale Ave. San Pedro, CA 90731
21	H	490 - 091 - 16	T.11N.,R.4W.; Section 21; E½ of NE¼ of NW¼; except mineral rights reservation of record	20 M/L	Desert; vacant	On dry lake, near marsh	T. Vaccaro	27914 Sol Vista ln. Rancho Palos Verde, CA 90274
21	I	490 - 091 - 17	T.11N.,R.4W.; Section 21; W½ of NW¼ of NW¼; except mineral rights reservation of record	20	Desert; vacant	On dry lake, adjacent to marsh	M.H. Newton	3512 Windspun Dr. Huntington Beach, CA 92649
21	J	490 - 091 - 18	T.11N.,R.4W.; Section 21; E½ of NW¼ of NW¼; except mineral rights reservation of record	20	Desert; vacant	On dry lake, near marsh	S.D. Powell	10012 Rodeo Ct. Cypress, CA 90630
28	A	490 - 131 - 01	T.11N.,R.4W.; Section 28; W½ of NW¼; except mineral rights reservation	80	Desert; vacant	On marsh	E.A. Duitsman, B.C. Duitsman, *et al.*	602 E. Main St. Barstow, CA 92311
28	B	490 - 131 - 02	T.11N.,R.4W.; Section 28; NE¼ and N½ of SE¼ and E½ of NW¼	320	NL	On marsh and dry lake	USA	NL
28	C	490 - 131 - 03	T.11N.,R.4W.; Section 28; S½ of SE¼	80	Desert; vacant	Adjacent to marsh	G.R. Phillips	1005 Stradella Rd. W. Los Angeles, CA 90024
28	D	490 - 131 - 11	T.11N.,R.4W.; Section 28; NW¼ of SW¼	40	Desert; vacant	Adjacent to marsh	H. Snider and M.W. Snider	5202 190th St. Torrance, CA 90503

Continued next page

Table 3.1-2 (Cont'd.). LAND OWNERSHIP AND USE WITHIN THE HARPER DRY LAKE STUDY AREA

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
28	E	490 - 131 - 12	T.11N.,R.4W.; Section 28; SW¼ of SW¼	40	Desert; residence	Near marsh	K.E. Hays and J.M. Hays	Ancillary Insurance Management Systems, Inc., Box 15547 Santa Ana, CA 92705
28	F	490 - 131 - 13	T.11N.,R.4W.; Section 28; E½ of SE¼ of SW¼	20	Desert; vacant	Near marsh	H.V. Hernandez *et al.*	13823 Almetz St. Sylmar, CA 91342
28	G	490 - 131 - 15	T.11N.,R.4W.; Section 28; W½ of SE¼ of SW¼; except mineral rights reservation of record	20	Desert; vacant	Near marsh	K.E. Hays and J.M. Hays	4158 Francis Ave. Chino, CA 91710
28	H	490 - 131 - 16	T.11N.,R.4W.; Section 28 NE¼ of SW¼; except mineral rights reservation of record	40	Desert; vacant	On marsh	K.E. Hays and J.M. Hays	Ancillary Insurance Management Systems, Inc. Santa Ana, CA 92705
29	A	490 - 131 - 06	T.11N.,R.4W.; Section 29; SE¼	160	Agriculture; residence (Lockhart Ranch)	Near marsh	A. Cotten and H.G. Cotten	P.O. Box 590 San Bernardino, CA 92402
29	B	490 - 131 - 07	T.11N.,R.4W.; Section 29; SW¼	160	Agriculture; residence (Lockhart Ranch)	Near marsh	A. Cotten and H.G. Cotten	P.O. Box 590 San Bernardino, CA 92402
29	C	490 - 131 - 08	T.11N.,R.4W.; Section 29; W½ of NW¼	80	Agriculture; residence (Lockhart Ranch)	Near marsh	A. Cotten and H.G. Cotten	P.O. Box 590 San Bernardino, CA 92402
29	D	490 - 131 - 09	T.11N.,R.4W.; Section 29; E½ of NW¼	80	Desert; vacant	Adjacent to and on marsh	E.E. Murdock and F. Murdock	2300 W. Thoreau Inglewood, CA 90303
29	E	490 - 131 - 10	T.11N.,R.4W.; Section 29; NE¼	160	Desert; vacant	Near marsh	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105

[1]Parcel letters refer to Figure 7.
M/L=More or less
NL =Information not listed

Source: Assessor's Office; San Bernardino County, California; 1978.

The predominant land use designation within the Harper Dry Lake study area is "desert; vacant." However, the subdivisions of section 29 shown as parcels A, B, and C are designated as "agriculture; residence" and form part of the Lockhart Ranch holdings. The agricultural development and groundwater irrigation of these parcels have been responsible for the accumulation of runoff along the southwestern margin of the dry lake bed and the consequent formation of the marshy area with its associated wetland vegetation.

The subdivision of section 28 shown as parcel B is federally owned and under the jurisdiction and management of BLM; controlled grazing of livestock is allowed there, and signs of off-road vehicle use are common. The eastern portion of the Harper Dry Lake area is federal land comprising part of the BLM Barstow Resource Area.

3.1.3 Afton Canyon

The ownership status of the Afton Canyon study area is presented in two parts: the western sector (Figure 8A) and the eastern sector (Figure 8B). Land ownership throughout the area generally follows a checkerboard pattern alternating between publicly and privately owned sections. However, some subdivision has taken place, as indicated by the lettered parcels in Figures 8A and 8B; these letters correspond to Table 3.1-3, which also is divided between the western sector (part A) and the eastern sector (part B).

The County of San Bernardino has formally designated the Afton Canyon area as a Rural Conservation Zone, limiting parcel size to a 40-acre minimum. This policy is intended to protect the existing undisturbed features of the area and to regulate future population growth and physical development there (22,23).

Land use throughout the Afton Canyon study area is designated predominatly as "desert; vacant" by the San Bernardino County Assessor's Office. This description, however, is somewhat misleading when applied generally to the

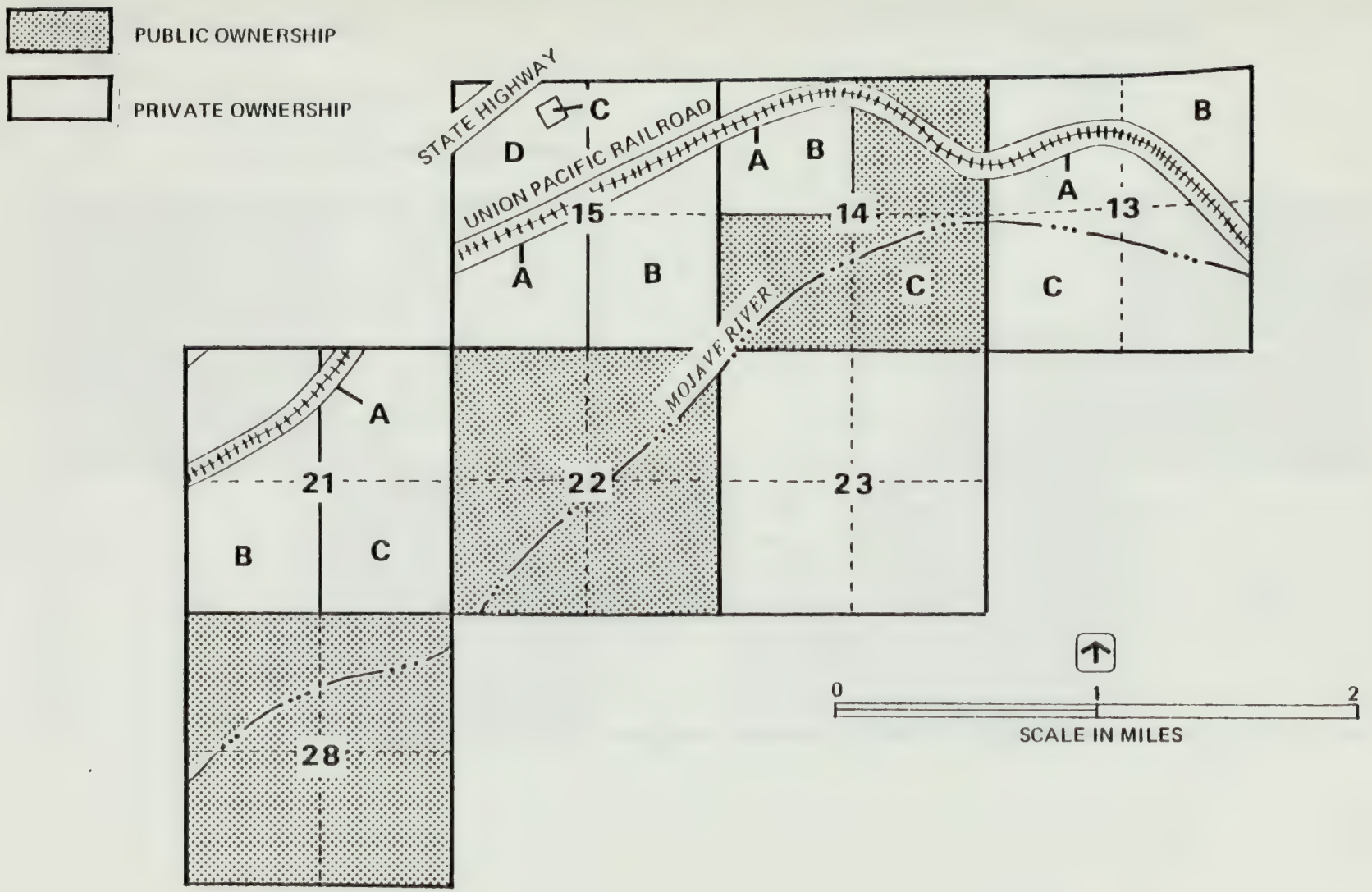

FIGURE 8A: OWNERSHIP STATUS OF THE AFTON CANYON STUDY AREA, WESTERN SECTOR. PARCEL LETTERS REFER TO TABLE 3.1-3(A)

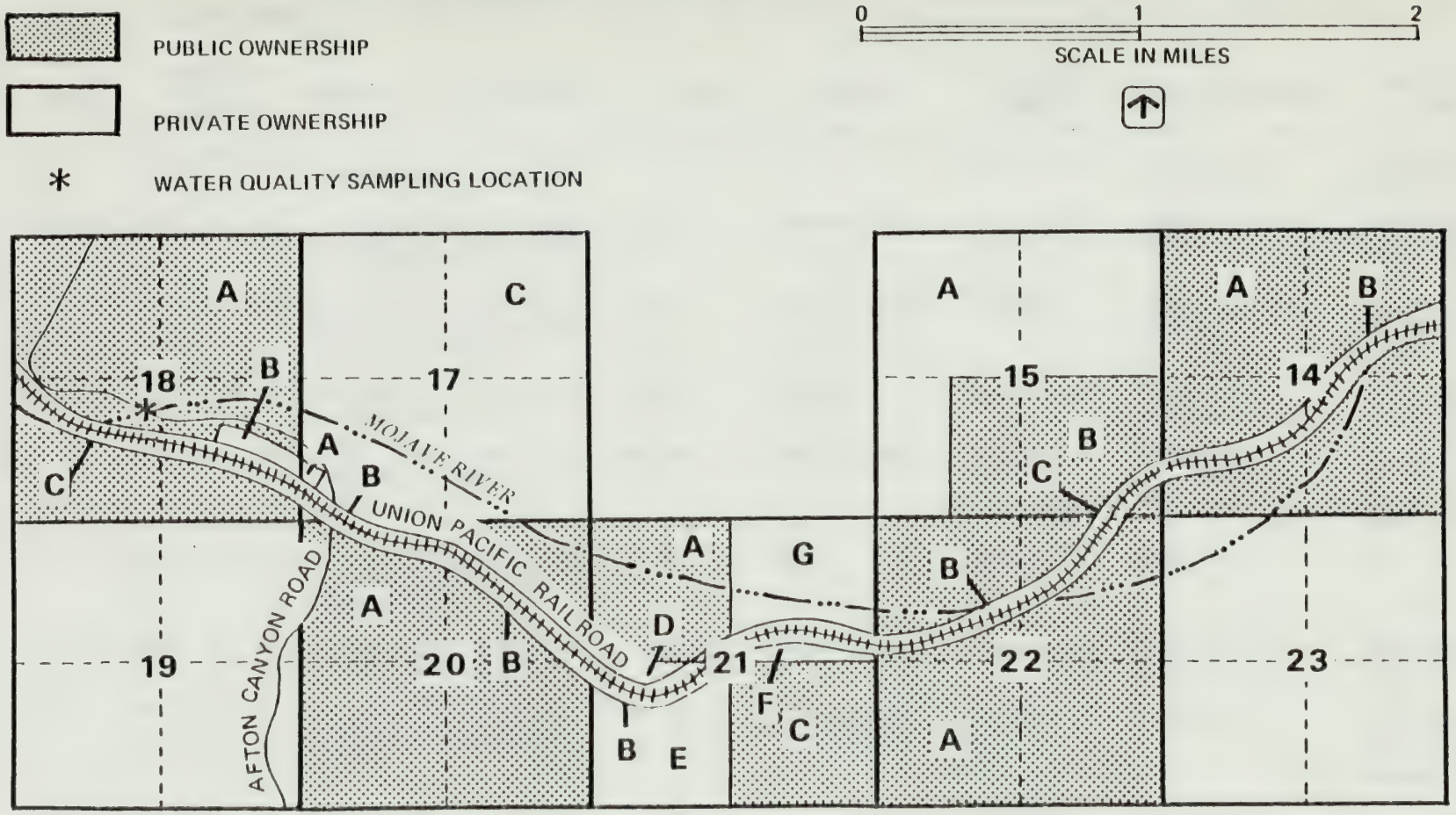

FIGURE 8B: OWNERSHIP STATUS OF THE AFTON CANYON STUDY AREA , EASTERN SECTOR. PARCEL LETTERS REFER TO TABLE 3.1-3(B)

Table 3.1-3. LAND OWNERSHIP AND USE WITHIN THE AFTON CANYON STUDY AREA

A. WESTERN SECTOR

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
13	A	542 - 141 - 08	T.11N.,R.5E.; Fractional Section 13; Parcel 6	14.37	RR R/W	Near creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
13	B	542 - 141 - 16	T.11N.,R.5E.; Fractional Section 13; that portion lying N of RR R/W	NL	Desert; vacant	Adjacent to creek	Southern Pacific Land Co.	One Market St.,Rm.200 San Francisco, CA 94105
13	C	542 - 141 - 17	T.11N.,R.5E.; Fractional Section 13; that portion lying S of RR R/W	NL	Desert; vacant	On creek	Southern Pacific Land Co.	One Market St.,Rm.200 San Francisco, CA 94105
14	A	542 - 141 - 05	T.11N.,R.5E.; Fractional Section 14; Parcel 1	26.29	RR R/W	Near creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
14	B	542 - 141 - 06	T.11N.,R.5E.; Fractional Section 14; NW¼; except RR R/W	148 M/L	Desert; vacant	Adjacent to creek	H. Mulryan; R.T. Vanderbilt Co., Inc.	c/o Western Talc Co., Inc. Box 368 Yermo, CA 92398
14	C	542 - 141 - 07	T.11N.,R.5E.; Fractional Section 14; S½ and NE¼ except RR R/W	477.20	NL	On creek	USA	NL
15	A	542 - 141 - 03	T.11N.,R.5E.; Fractional Section 15; Parcel 6	13.61	RR R/W	Near creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
15	B	542 - 141 - 04	T.11N.,R.5E.; Fractional Section 15; E½; except RR R/W	316.78	Mining (mineral extraction)	Adjacent to creek	Tenneco Oil Co.	c/o American Borate Corporation P.O. Box 2511 Houston, TX 77001
15	C	542 - 141 - 14	T.11N.,R.5E.; Fractional Section 15; Parcel 1	1.27	NL	Near creek	Southern California Edison Co.	NL
15	D	542 - 141 - 15	T.11N.,R.5E.; Fractional Section 15; W½; that portion lying S of state highway; except RR R/W and Parcel 1	298.33 M/L	Desert; vacant	Near creek	L.P. Groves; N.P. Powell	c/o Desert Minerals 840 S. Mission Rd. Los Angeles, CA 90023

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Table 3.1-3 (Cont'd.). LAND OWNERSHIP AND USE WITHIN THE AFTON CANYON STUDY AREA

A. WESTERN SECTOR

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER)S)	MAILING ADDRESS OF OWNER(S)
21	A	542 - 141 - 05	T.11N.,R.5E.; Fractional Section 21; Parcel 4	9.73	RR R/W	Near creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
21	B	542 - 111 - 28	T.11N.,R.5E.; Fractional Section 21; W½; except state highway and except RR R/W and except mineral rights reservation of record	310.36 M/L	Desert; vacant	On creek	R.F. Kelly	P.O. Box 9104 Bullhead City, AZ 86430
21	C	542 - 111 - 29	T.11N.,R.5E.; Fractional Section 21; E½ except RR R/W and except mineral rights reservation of record	311.35 M/L	Desert; vacant	On creek	L.B. Clark; N.B. Clark	2827 Muscupiabe Dr. San Bernardino, CA 92405
22	-	542 - 141 - 12	T.11N.,R.5E.; Section 22	640	NL	On creek	USA	NL
23	-	542 - 141 - 11	T.11N.,R.5E.; Section 23	640	Desert; vacant	On creek	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105
28	-	542 - 101 - 10	T.11N.,R.5E., Section 28	655.40	NL	On creek	USA	NL

[1]Parcel letters refer to Figure 8A.
RR R/W=Railroad right of way
M/L =More or less
NL =Information not listed

Source: Assessor's Office; San Bernardino County, California; 1978.

Table 3.1-3. LAND OWNERSHIP AND USE WITHIN THE AFTON CANYON STUDY AREA

B. EASTERN SECTOR

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
14	A	542 - 211 - 04	T.11N.,R.6E.; Fractional Section 14; except RR R/W	588.78 M/L	NL	On creek	USA	NL
14	B	542 - 211 - 05	T.11N.,R.6E.; Fractional Section 14; Parcel 4	27.05	RR R/W	Adjacent to & over creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
15	A	542 - 211 - 01	T.11N.,R.6E.; Section 15; N½ and W½ of SW¼	400	Desert; vacant	Near creek	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105
15	B	542 - 211 - 02	T.11N.,R.6E.; Section 15; E½ of SW¼ and SE¼; except RR R/W	236.81 M/L	NL	On creek	USA	NL
15	C	542 - 211 - 03	T.11N.,R.6E.; Section 15; Parcel 3	3.19	RR R/W	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
17	A	542 - 171 - 04	T.11N.,R.6E.; Section 17; Parcel 5	3.6	NL	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
17	B	542 - 171 - 05	T.11N.,R.6E.; Section 17; Parcel 6	3.87	RR R/W	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
17	C	542 - 171 - 06	T.11N.,R.6E.; Section 17; except Parcel 5 and RR R/W	632.53	Desert; vacant	On creek	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105
18	A	542 - 171 - 01	T.11N.,R.6E.; Fractional Section 18; except Parcel B and RR R/W	606.8	22-unit desert campground	On creek	USA	Barstow Way Stn. Bureau of Land Management 831 Barstow Rd. Barstow, CA 92311
18	B	542 - 171 - 02	T.11N.,R.6E.; Fractional Section 18; Parcel 4	16.4	Residence	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
18	C	542 - 171 - 03	T.11N.,R.6E.; Fractional Section 18; Parcel 3	27.44	RR R/W	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179

Continued next page

Table 3.1-3 (Cont'd.). LAND OWNERSHIP AND USE WITHIN THE AFTON CANYON STUDY AREA

B. EASTERN SECTOR

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
19	-	542 - 171 - 14	T.11N.,R.6E.; Fractional Section 19	650.8	Desert; vacant	Near creek	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105
20	A	542 - 171 - 13	T.11N.,R.6E.; Section 20; except RR R/W	615.08 M/L	NL	On creek	USA	NL
20	B	542 - 171 - 15	T.11N.,R.6E.; Section 20; Parcel 7	24.92	RR R/W	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
21	A	542 - 171 - 10	T.11N.,R.6E.; Section 21; NW¼; except RR R/W	158.39 M/L	NL	On creek	USA	NL
21	B	542 - 171 - 11	T.11N.,R.6E.; Section 21; Parcel 1	13.56	RR R/W	Adjacent to creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
21	C	542 - 171 - 12	T.11N.,R.6E.; Section 21; SE¼	160	NL	Near creek	USA	NL
21	D	542 - 171 - 27	T.11N.,R.6E.; Section 21; SW¼; that portion lying N of RR R/W	NL	Desert; vacant	Adjacent to creek	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105
21	E	542 - 171 - 28	T.11N.,R.6E.; Section 21; SW¼; that portion lying S of RR R/W	NL	Desert; vacant	Near creek	Southern Pacific Land Co.	"
21	F	542 - 171 - 29	T.11N.,R.6E.; Section 21; NE¼; that portion lying S of RR R/W	NL	Desert; vacant	Adjacent to creek	Southern Pacific Land Co.	"
21	G	542 - 171 - 30	T.11N.,R.6E.; Section 21; NE¼; that portion lying N of RR R/W	NL	Desert; vacant	On creek	Southern Pacific Land Co.	"
22	A	542 - 211 - 08	T.11N.,R.6E.; Section 22; except RR R/W	616.86	NL	On creek	USA	NL

Continued next page

Table 3.1-3 (Cont'd.). LAND OWNERSHIP AND USE WITHIN THE AFTON CANYON STUDY AREA

B. EASTERN SECTOR

SECTION	PARCEL[1]	ASSESSOR'S PARCEL DESCRIPTION	ASSESSOR'S LEGAL DESCRIPTION	ACRES	LAND USE	DESCRIPTIVE COMMENTS	NAME(S) OF OWNER(S)	MAILING ADDRESS OF OWNER(S)
22	B	542 - 211 - 09	T.11N.,R.6E.; Section 22; Parcel 2	23.14	RR R/W	Over creek	Union Pacific Railroad Co.	1416 Dodge St. Omaha, NE 68179
23	-	542 - 211 - 07	T.11N.,R.6E.; Section 23	640	Desert; vacant	On creek	Southern Pacific Land Co.	One Market St. Room 200 San Francisco, CA 94105

[1]Parcel letters refer to Figure 8B.
M/L =More or less
NL =Information not listed
RR R/W=Railroad right of way

Source: Assessor's Office; San Bernardino County, California; 1978.

area, because Afton Canyon is a well-known regional focal point for outdoor recreation, enhanced by the 22-unit BLM campground situated in section 18 of the eastern sector (24). Moreover, a Union Pacific Railroad right-of-way follows the Mojave River through Afton Canyon, crossing the river at three places within the study area. Vehicle traffic relating to maintenance of the right-of-way and providing access to the residence in section 18 occurs across the Afton Road ford, along with crossings related to outdoor recreation. Public land in the area under BLM jurisdiction forms part of the BLM Cima Resource Area.

3.2 Existing Water Rights Status

3.2.1 San Sebastian Marsh

Under the California Doctrine, the State of California recognizes a dual system of water rights governed both by common law and by statute, and applying in essentially the same fashion both to surface water and to groundwater useage (25). Because of its remoteness and lack of population, the San Sebastian Marsh study area continues to provide free access to surface flow and groundwater within the confines of "reasonable use" under riparian rights to surface water and correlative rights to the underlying aquifer or aquifers. No statute-governed appropriative water use permits have been applied for or granted within the study area, reflecting the absence of demand for surface water and groundwater and the lack of agricultural, residential, and other land uses in the area. This lack of judicature means that all rights to surface water and groundwater within the San Sebastian Marsh study area are riparian and correlative, respectively, and are subject to subsequent statutory judicature and appropriative regulation by the State of California (26,27).

The Imperial Irrigation District has jurisdiction over the waters of San Felipe and Corrizo Creeks to the west and south of (upstream from) their confluence within the San Sebastian Marsh. However, the study area is not included within the Imperial Irrigation District's boundary. Serving the

entire Imperial Valley with a complex system of irrigation canals and smaller channels, the Imperial Irrigation District shares Colorado River water with equivalent agencies in Arizona and Nevada; this water is transported to the Imperial Valley, where it becomes the main supply for irrigation. San Felipe and Carrizo Creek waters are not used for irrigation; their irregular flows are considered to be unreliable for this purpose (25).

3.2.2 Harper Dry Lake Area

Privately owned land within the Harper Dry Lake study area is zoned for 20 to 40 acres minimum parcel size, in keeping with the established policy of the County of San Bernardino to maintain the area in agricultural, non-residential useage (22,23). Because the area is not served by a water company or irrigation district, landowners tap the aquifer underlying their properties through individual or cooperative efforts. Permits have been obtained for this purpose from the State Water Resources Control Board, the County of San Bernardino, and the Mojave Water Agency. However, these permits are required primarily for record-keeping purposes and do not regulate the quantity or use of tapped groundwater. The groundwater rights of property owners within the Harper Dry Lake study area must therefore be viewed as correlative rather than appropriative, because judicature establishing limits to withdrawal and use has not been made. All existing correlative groundwater rights of landowners within the study area remain subject to later judicature and appropriative permitting by the State of California, if cases should arise in which the existing correlative status of reasonable use and sharing of groundwater is questioned (4,22,23).

3.2.3 Afton Canyon

There has been no judicature of rights to surface water or groundwater within the Afton Canyon study area. All owners of property containing portions of the bed of the Mojave River have riparian rights to its surface flow within the context of reasonable use and sharing, whether or not the water is actually used for any purpose. Similarly, all landowners

within the area have correlative rights to the underlying aquifer or aquifers (25). Although any property owner wishing to drill a well must file for a permit with the State Water Resources Control Board, the County of San Bernardino, and the Mojave Water Agency, this procedure is for record-keeping purposes and does not constitute appropriative regulation by the State of California (4,22,23). Landowners within the Afton Canyon study area therefore have full rights to surface water and groundwater within the context of the California Doctrine, subject to subsequent judicature.

3.3 Projected Water Rights Trends

3.3.1 San Sebastian Marsh

According to representatives of the County of Imperial and the Imperial Irrigation District, the land use status of the San Sebastian Marsh study area is likely to remain relatively unchanged within the foreseeable future. Predominant land uses are expected to remain recreational and scientific and therefore to have little impact on the future status of water rights governing the surface flow and aquifers of the area (26,27).

Lands to the west and south of (upstream from) the study area contain soil which is considered to be among the most fertile in the Imperial Valley and therefore highly suitable for future agricultural development. Because of this favorable agricultural potential, properties directly adjacent to the San Sebastian Marsh area as defined herein, to the west and south of the springs feeding the flow sampled in the present study, are likely to be annexed eventually by the Imperial Irrigation District. However, subsequent irrigation for agricultural development of these lands would be achieved through extensions of the existing canal system and would involve Colorado River water. Because the surface flows of San Felipe and Carrizo Creeks are considered to be unreliable and economically unfeasible for irrigation, it is unlikely that these creeks and their tributaries will become subject to the time-consuming and expensive process of appropriative judicature and statutory regulation by the State of California (26,27).

3.3.2 Harper Dry Lake Area

The predominantly agricultural land use status of the Harper Dry Lake study area is expected to remain essentially unchanged in the foreseeable future, reflecting existing policies of zoning and land use planning by the County of San Bernardino. Little population growth is expected. The permitting process monitoring the establishment of groundwater wells for domestic and agricultural purposes will continue under the cooperative supervision of the State Water Resources Control Board, the County of San Bernardino, and the Mojave Water Agency. However, appropriative judicature of groundwater rights by the State of California is not foreseen (22,23).

3.3.3 Afton Canyon

The Afton Canyon area is a Rural Conservation Zone limited by the County of San Bernardino to a minimum subdivision parcel size of 40 acres, and little population growth or change in land use is expected to occur within the immediate vicinity. However, the projected trend for communities and industrial sites along the Mojave River upstream from the study area is towards continuing residential and commercial development (4,22,23).

The relationship between groundwater and surface flow along the Mojave River watershed is complex, because the river alternately percolates into and emerges from the underlying aquifers, depending on the physical characteristics of the bedrock, its distance from the surface, and the season of the year. Groundwater obtained for domestic use along the course of the Mojave River is not limited in quantity; permits obtained for this purpose are used for record-keeping rather than for regulation. Rights to ground and surface flow have not been judicated in most cases. A cooperative system of water use agreements among municipalities, water districts, businesses, and individuals exists without appropriative regulation. Although this system does not extend to Afton Canyon, it ultimately governs the quality and flow of Mojave River water through the canyon. Continued

residential and industrial growth upstream, as projected, will undoubtedly produce increases in water use and storage, and result in greater demands for withdrawals from the Mojave River watershed. New civil suits and subsequent judicative changes in the status of surface water and groundwater rights could severely reduce the surface flow through Afton Canyon. It is recognized that overdrafting is occurring along the Mojave River basin, but, according to San Bernardino County officials, little or no action has been taken to alleviate this situation. Therefore, negative impacts to the surface flow and quality of Mojave River water at Afton Canyon are predicted if present trends continue (4,22,23).

4.0 EVALUATION OF EXISTING CONDITIONS AND PROJECTED TRENDS

4.1 San Sebastian Marsh

4.1.1 Land Use

Land use within the San Sebastian Marsh study area is predominantly recreational. There also is great potential for zoological, botanical, and geological field research throughout the complex system of floodplains and rainfall runoff channels. The official designation of sections under BLM administration as the San Sebastian Natural Area and the consequent closing of these sections to off-road vehicle use is a positive step in reducing the extreme susceptibility of the fine soils of the area to wind and water erosion.

Eventual agricultural development of the fertile lands directly to the south and west of the San Sebastian Marsh may change the area's role in the regional support of wildlife, alter vegetation characteristics, and produce changes in the quantity and quality of surface water flowing through and maintaining the unique characteristics of this desert wetland. However, such development is not foreseen in the near future, and any influences of existing land uses on the water quality of the San Sebastian Marsh are expected to continue in a relatively static fashion until the policies governing these land uses are altered.

4.1.2 Water Quality

Objectives for surface water quality applicable to San Felipe Creek have been established by the State Water Resources Control Board and the California Regional Water Quality Control Board, Colorado River Basin Region (16). These objectives, with an accompanying description of physical and hydrologic characteristics of the West Colorado River Basin, are presented in Appendix G.

The water quality of San Felipe Creek where sampled within the San Sebastian Marsh is generally poor. Specific parameters and constituents which do not meet the water quality standards established for the West Colorado River Basin are discussed as follows:

- Suspended Material: Suspended sediment within San Felipe Creek was excessively high in concentration at the time and location of sampling. The coffee-colored water and turbidity of 36 nephelometric turbidity units indicate a very heavy load of suspended material. Field observations indicate that soil is eroding into the main creekbed on a continuing basis and that this siltation is almost certainly responsible for the high sediment load and extremely muddy conditions existing there.

- Settleable Material: The thick layers of sediment which began to settle onto the bottoms of water containers immediately following sampling of San Felipe Creek indicate a heavy load of settleable material in the water.

- Turbidity: The measured value of 36 nephelometric turbidity unit is 4 units short of the maximum range of the turbidimeter and indicates a significant lack of clarity of the water. Values above 40 nephelometric turbidity units can properly be measured only if the sample is diluted according to established procedures (5).

- Boron: The boron concentration of 2.86 milligrams per liter exceeds the limit of 0.50 milligrams per liter established for surface waters designated for agricultural useage (16).

Concentrations measured for total phosphate, dissolved oxygen, bacteria, nitrate nitrogen, copper, and zinc are all below established maximum

limits (16). However, the total dissolved solids concentration of 6,522 milligrams per liter exceeds the maximum limit of 4,500 milligrams per liter established for Imperial Valley irrigation drains (16). Furthermore, the high concentrations obtained for total hardness as calcium carbonate, total calcium, total magnesium, and sulfate all indicate that the water of San Felipe Creek would be unsuitable for agricultural irrigation or industrial purposes because of its potential for crystallization. Salt crystals would be likely to form in pipes and around the bases of plants, especially with day-night temperature differentials; calcium carbonate precipitation as an insoluble salt would create especially severe problems of blockage and fouling in pipes and on vegetation.

At the present time, it does not appear that water quality within the San Sebastian Marsh area will be altered by changing land uses. However, if the land area to the west and south of the sampling location is developed for agricultural use, and if the existing Imperial Irrigation District system is extended to support such development, the water quality of Carrizo and San Felipe Creeks will probably change, because these watersheds provide the primary drainage system for the higher lands upstream. Chemical constituents relating to agriculture, including organic compounds beyond the scope of the present investigation, are likely to increase.

The steady load of sediment removed from the San Sebastian Marsh area and carried downstream towards the Salton Sea is expected to continue. It will be mitigated if the San Sebastian area remains closed to off-road vehicle use. However, the deposition of mud along the course of San Felipe Creek and the gradual contribution of silt to the bed of the Salton Sea will continue to be a problem requiring attention in the future.

4.1.3 Water Rights

No statute-governed appropriative water use permits have been applied for or granted within the San Sebastian Marsh study area (26,27). Landowners have riparian rights to surface water and correlative rights to groundwater by common law under the California Doctrine. This means

that owners of property with access to surface water or groundwater have the automatic right to these waters within the context of reasonable use and sharing. Use is limited to the property from which the water is obtained and must not interfere with the use or access of other property owners sharing the surface flow or aquifer (25).

It is unlikely that the status of water rights within the San Sebastian Marsh study area will alter in the near future, because residential, agricultural, or other development of sections within the area is not foreseen (26,27). If a situation were to arise in which water use by one landowner was contested by another on the grounds of inequitable sharing of the surface flow or aquifer, a legal suit would normally be filed with the State of California requiring judicature of the water rights of the interested parties. Subsequently, permits defining and limiting appropriative water rights would be issued.

If lands to the south and west of the San Sebastian Marsh area are developed for agriculture, the water used for irrigation would be transported by extensions to the existing canal system from the Colorado River by the Imperial Irrigation District; surface waters of Carrizo and San Felipe Creeks would not be involved (27). Therefore, it is unlikely that any existing minimal use of these waters by property owners within the San Sebastian Marsh would be affected, or that a transition to appropriative permitting would be necessary.

4.2 Harper Dry Lake Area

4.2.1 Land Use

The predominant land uses within the Harper Dry Lake study area are agriculture, grazing, and recreation. Sections immediately to the east of the study area are owned primarily by BLM and managed as part of the Barstow Resource Area. Within the context of the present study, any change in the existing status of irrigation farming at the Lockhart Ranch would require critical attention, because runoff water from this

irrigation is responsible for maintaining the marshy southwestern border area of the dry lake and thus plays a significant role in the regional support of wildlife.

It is the intention of the County of San Bernardino to perpetuate the agricultural, prodominantly non-residential status of the Harper Dry Lake area. Privately owned land there will continue to be zoned for 20 or 40 acres minimum parcel size, in keeping with this policy. It is therefore unlikely that any significant change in the land-use status of the study area will occur in the foreseeable future (22,23).

4.2.2 Water Quality

The water quality of pools within the Harper Dry Lake study area must be evaluated within the context of the water's origin as irrigation runoff and its role in maintaining a fragile and unique ecosystem, rather than in the usual context of suitability for uses relating to human activities, upon which most established water quality standards and objectives are based.

General objectives applicable to surface water of the Harper Dry Lake area have been established by the State Water Resources Control Board and the California Regional Water Quality Control Board, Lahontan Region (21). These objectives, with an accompanying description of physical and hydrologic characteristics of the South Lahontan Basin, are presented in Appendix G. Specific, quantitative objectives for chemical water quality have been established for major surface waters within the South Lahontan Basin, but the Harper Dry Lake area is not included in these standards. Therefore, only the more general, qualitative objectives apply directly to Harper Dry Lake.

The outstanding feature of the sampled water is soluble salt accumulation. Concentrations of calcium, magnesium, sodium, potassium, sulfate, and chloride are very high, reflecting the continuing cyclic process of runoff accumulation, evaporative salt concentration, and runoff replenishment that

occurs within this system. The high total hardness of the water as calcium carbonate and the large measured concentrations of boron and iron probably also result from this process. These concentrated constituents are obviously unsuitable for irrigation or industrial uses, but these applications are not at issue, because the water concerned evaporates and is not significantly involved in human-related activities.

The measured concentration of fecal coliform bacteria falls well within the limits established by the State of California for contact recreation, and the values for total coliform and fecal streptococcus probably reflect the frequent visits of birds and mammals to this small, highly localized volume of water.

Levels of total dissolved solids and values for conductivity, salinity, and turbidity indicate evaporative salt loading and the accumulation of organic and inorganic constituents from vegetation decay and fecal deposition. A heavy layer of detritus covers the floors of the pools; microscopic examination indicated that this layer is composed of decaying vegetable matter, including fecal material.

The benthic faunal community is limited to organisms which are mostly tolerant to high salinity, still water, and periodic drying. The predominant taxon in terms of population size, larval flies belonging to the family Tendipedidae (Chaoboridae), is entirely consistent with these conditions. Larval members of this family may occupy the moist interstices of plant root systems and continue to respire dissolved oxygen when all appreciable surface water has evaporated (18).

Levels of dissolved oxygen and chemical and biochemical oxygen demands are sufficient for the support of healthy plant and animal communities. This point is especially significant because still waters along the fringes of ponds, marshes, or reservoirs may be sufficiently anaerobic to support the growth of *Botulinus*. The botulism toxin produced by this microorganism may be especially dangerous to the waterfowl which this type of habitat also supports. In the present case, the dissolved oxygen concentrations would prevent the general occurrence of *Botulinus* (21).

In view of the agricultural source of the water in question and the significant role of this water in supporting vegetation and wildlife, an additional water quality parameter beyond the scope of the present investigation requires particular attention: the potential presence of organic pesticide or fertilizer constituents. This subject is addressed within Section 5.2, Recommended Management Guidelines for the Harper Dry Lake Area.

4.2.3 Water Rights

Because of the absence of surface water in quantities sufficient for human use, only groundwater rights within the Harper Dry Lake study area are appropriate for discussion. These rights are correlative and subject to future judicature by the State of California. Property owners are entitled to the free use of the aquifer underlying their land, provided that such use is confined to the same land area and does not interfere with the availability of groundwater to other landowners on the basis of reasonable use and sharing (25). In light of the existing policy of the County of San Bernardino to limit population growth in the area, it is unlikely that the status of groundwater rights will change in the near future.

4.3 Afton Canyon

4.3.1 Land Use

Land use within the Afton Canyon study area has created a significant potential for negative impacts to the riparian environment there. Members of the San Bernardino County Environmental Improvement Agency have stated that the 22-unit BLM campground at Afton Canyon has contributed to the deterioration of water quality in the area, particularly as the result of a recent camping-related fire which destroyed stabilizing riparian vegetation and consequently led to soil erosion (22,23). As a regional focal point for recreational activity, the campground inevitably attracts

vehicular traffic, and because of the campground's proximity to the Mojave Riverbed, this vehicle use probably affects to some extent the vegetation and soils bordering the river. The main route of access to the canyon area is provided by the Afton Road ford, which is directly adjacent to the campground and reached by the continuation of the road serving the campground. Inspection of the ford during and immediately following vehicle crossings indicated that sediment disturbances and transient increases in turbidity are produced. The lack of vegetation and absence of channel definition at the ford contrasts greatly to areas upstream and downstream, as shown by a comparison of Plates 16 and 17.

It is unknown to what extent the active railroad route through Afton Canyon affects the water quality and riparian environment there. Effects of train traffic along the right-of-way are probably negligible, although maintenance activities and related vehicular crossings of the river at the Afton Road ford may produce slight impacts.

Any assessment of the effects of land use on environmental quality at Afton Canyon must recognize that the area is specifically designated for recreational activity, and that the detrimental effects of this human activity on the water quality, soil integrity, and vegetation of the area must be weighed against the positive human values of outdoor recreation and the benefits provided to users of the area.

4.3.2 Water Quality

As discussed in Section 2.3.3, the water quality of the Mojave River at Afton Canyon is generally excellent. Although a question exists concerning the large recorded concentration of total coliform bacteria, concentrations of other bacterial indicators are all within established limits (21). The community of benthic invertebrate fauna shows a diversity typical of healthy streams. With the exception of values for total dissolved solids, chloride, fluoride, and boron, concentrations of chemical constituents meet all of the water quality objectives established for the South Lahontan Basin (21).

In general, only the fluoride concentration of the sampled Mojave River water is excessively high, although the boron concentration is rather large also. The concentration of total dissolved solids exceeds the limit established for Mojave River water at Victorville, but the recorded value is consistent with superior water quality (21). No sampled parameter indicates that the water is not fully suitable for the human contact that occurs as a normal part of the recreational activities at Afton Canyon.

From the standpoint of agricultural or industrial use, the sampled water is excellent. The recorded levels of trace metals are acceptable for any purpose, and the total hardness as calcium carbonate, salinity, and chemical oxygen demand values are entirely suitable for irrigation.

Because of its dependence on a diversity of changing land uses upstream and on the intensity of recreational activities taking place at Afton Canyon, the water quality at the sampling site is highly vulnerable and subject to change. It is probable that many of the factors which may lead to water quality deterioration will be beyond the jurisdiction and control of BLM. This problem is discussed at greater length in Section 5.3, Recommended Management Guidelines for Afton Canyon.

4.3.3 Water Rights

The surface water and groundwater rights of property owners within the Afton Canyon study area are riparian and correlative, respectively, reflecting the fact that judicature of water rights by the State of California has not occurred. It is not foreseen that the status of water rights within the Afton Canyon area itself will change to an appropriative status in the near future, because the area has been formally designated a Rural Conservation Zone by the County of San Bernardino (22,23). As

discussed in Section 3.3.3, however, the status of water rights associated with the projected population growth of communities upstream will probably become increasingly appropriative in the future. Water uses upstream will increase and diversify, resulting in greater removal and storage of water before it reaches Afton Canyon. The San Bernardino County Environmental Improvement Agency recognizes that overdrafting is now occurring throughout many areas of the Mojave River Basin, and that this problem will have to be controlled through increased appropriative judicature and permitting in the future [22,23].

5.0 RECOMMENDED MANAGEMENT GUIDELINES

5.1 San Sebastian Marsh

The status of environmental quality within the San Sebastian Marsh is characterized by four basic, inter-related problems:

1. Severe soil erosion by rainfall runoff throughout the watershed

2. Heavy sediment deposition within the beds of San Felipe Creek and its tributaries

3. Generally poor water quality accompanied by low levels of biotic productivity within San Felipe Creek

4. Lack of knowledge concerning the vulnerability of water quality to existing and future agricultural development of lands to the west and south of the area, within the same watershed

To alleviate these problems, a clearly defined water quality management policy must be established for the San Sebastian Marsh. The management program should relate in a realistic fashion to the existing and projected diversity of regional land uses, agencies and individuals, and public interests impinging on the area. Above all, the future management of the San Sebastian Marsh environment and water quality should reflect an appreciation of and sensitivity to the varity and fragility of this type of wetland riparian ecosystem within the California Desert.

Before a management policy for the San Sebastian Marsh can be established and effectively implemented, a well-defined strategy must be developed. Full and direct communication and consultation among all concerned public and private interests, with thorough, open review and discussion of the

environmental and management issues involved from all points of view, will be the only way to ensure the effective implementation of the resulting policy.

One possible strategy for the development of a management plan is outlined as follows:

1. Within BLM itself, there must first exist a clear definition of goals for land use and environmental quality within the San Sebastian Marsh. These goals should include at a minimum the following elements:

    - A commitment to soil stabilization and erosion reduction

    - A commitment to improving the physical, chemical, and biological quality of waters within San Felipe Creek and its tributaries

    - A clear definition of the types of land-use activities compatible with the above commitments, including what specific types of activities to be permitted or prohibited, and including reviews of outdoor recreation, amateur and professional scientific studies, geological or other collecting, and wildlife or botanical management programs to be conducted

2. Following the establishment by BLM of goals for enhancing and protecting the environmental quality of the area, there must be a program of planned communication and cooperative discussion with other appropriate agencies. At a minimum, these other agencies should include:

    - The County of Imperial Planning Department

    - The Imperial Irrigation District

- The California Department of Fish and Game

- The California Regional Water Quality Control Board, Colorado River Basin Region

In addition, this program of communication and discussion should include:

- All private property owners involved in the area

- Representatives of any agricultural interests having the potential to produce environmental impacts on the water quality of the area

- One or more local meetings designed to solicit the points of view of concerned members of the public

3. Following the widest practicable collection and detailed review of information through the above cooperative program, a Master Plan for the San Sebastian Marsh should be prepared under the sponsorship of BLM. The Master Plan should consist of three major parts:

   - A statement of governing principles and objectives which incorporates the views and interests of all concerned parties, but which emphasizes the primary goal of improving the environmental quality of the area

   - A detailed schedule of specific implementation procedures for environmental management

   - A program of field research designed to monitor selected environmental parameters and thus to assess the effectiveness of the management program on a continuing basis

As a result of the present investigation, it is possible to indicate specific areas of concern which should be incorporated into any Master Plan for the management of the San Sebastian Marsh. It is clear that the watershed of the San Sebastian area is in a condition which creates severe soil erosion. The factors contributing to this erosion are a general lack of stabilizing vegetation throughout the floodplain and irregular, seasonal rainfall producing extremes in runoff volumes and rates. The resulting heavy sedimentation has clogged the streambed with mud and prevented the substrate stability necessary to support a healthy community of aquatic plants and animals. Sediment deposition is also responsible for the more extreme water quality deficits of San Felipe Creek and has serious consequences for conditions downstream from the San Sebastian area, including flood control efforts and siltation rates within the Salton Sea.

The general absence of stabilizing vegetation within the floodplain is not surprising; heavy rainfall has dislodged vegetation and carried off topsoil, preventing re-colonization and normal plant succession. The bare and unstable condition of the soil is therefore self-perpetuating. The exotic tamaracks (*Tamarix* spp.) inhabiting the tributary bed margins are probably helping to alleviate the erosion and gradual widening of these runoff channels. Although a program of widespread tamarack seeding could be proposed, it would be preferable first to investigate the potential of seeding with California native plant species.

The following water quality parameters attributable in large measure to erosion and sediment deposition should receive remedial attention:

- suspended sediment
- total dissolved solids
- turbidity
- total hardness as calcium carbonate

As a result of the present investigation, it is possible to indicate specific areas of concern which should be incorporated into any Master Plan for the management of the San Sebastian Marsh. It is clear that the watershed of the San Sebastian area is in a condition which creates severe soil erosion. The factors contributing to this erosion are a general lack of stabilizing vegetation throughout the floodplain and irregular, seasonal rainfall producing extremes in runoff volumes and rates. The resulting heavy sedimentation has clogged the streambed with mud and prevented the substrate stability necessary to support a healthy community of aquatic plants and animals. Sediment deposition is also responsible for the more extreme water quality deficits of San Felipe Creek and has serious consequences for conditions downstream from the San Sebastian area, including flood control efforts and siltation rates within the Salton Sea.

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The following water quality parameters attributable in large measure to erosion and sediment deposition should receive remedial attention:

- suspended sediment
- total dissolved solids
- turbidity
- total hardness as calcium carbonate

The reduction of erosion into San Felipe Creek would help to stabilize the creekbed and allow plants to root there. Lower turbidity would enhance the penetration of sunlight through the water and contribute to plant growth, which would in turn contribute to creekbed stabilization and the establishment of benthic fauna. Reduction in sediment load would reduce organic debris which accumulates as a result of poor flushing through the wide, muddy channel, thus reducing oxygen consumption by bacteria and increasing its availability to plants and macrofauna. Moreover, reduced sediment deposition would eventually help to decrease flood levels throughout the area and aid groundwater recharge. Thus it is clear that the central emphasis of environmental management for the San Sebastian Marsh should focus on reducing erosion throughout the watershed (28,29).

Although the influence on chemical water quality of agricultural operations to the west and south of the sampling area is beyond the scope of the present investigation, an effort should be made to determine whether organic constituents of pesticides or fertilizers are present in San Felipe Creek. Trace amounts of heavy metals or chlorinated hydrocarbons, for example, may be responsible in part for the absence of normal plant and animal life in the creek. Any future management program should include the systematic monitoring of chemical water quality constituents, including synthetic organic compounds, on a twice-yearly basis to cover low-flow and high-flow periods.

5.2 Harper Dry Lake Area

Management guidelines for a program to protect the environmental quality of the marshy southwestern fringe of Harper Dry Lake need not be as comprehensive as those proposed for the much larger San Sebastian Marsh area. However, despite its comparative freedom from detrimental environmental impacts, the Harper Dry Lake study area requires continuing attention for two reasons:

- Its continuing dependence upon and vulnerability to neighboring agricultural operations

- Its status as a major regional contributor to the support of wildlife

The primary consideration in management of the marshy area at Harper Dry Lake should be coordination and cooperation between BLM and the management of the Lockhart Ranch or other agricultural operations in the vicinity. The quality and flow of irrigation runoff are critical in maintaining this wetland ecosystem in a healthy and productive state. The hydrologic processes involved in this maintenance are essentially cyclic, leading from the pumping of groundwater through irrigation, artificially enhanced runoff, settling, groundwater recharge (accompanied by evaporation), and pumping again. Thus the marshy area continually receives irrigation runoff which might carry any potentially dangerous chemical constituent used in the nearby agricultural operations, along with soluble salts. Any pesticide or fertilizer chemical present in the runoff would tend to concentrate during evaporation or filtration into the aquifer and would accumulate as the area is continually replenished with fresh runoff. Thus the potential exists for toxic levels of organic compounds to concentrate within a highly localized, shallow, low-volume wetland visited by significant numbers of migrating passerine birds and waterfowl, wintering shorebirds, grazing cattle, and local mammalian residents of the surrounding arid region.

Within this perspective, a management program should be developed with three basic objectives:

- To monitor chemical, biological, and physical water quality parameters on a continuing, regular basis

- To plan and control grazing, off-road vehicle use, and other land uses which can deteriorate water quality

- To work with the management of the Lockhart Ranch, Hays Farm, and other agricultural operations to ensure that future irrigation practices will be compatible with maintaining the wetland ecosystem in its healthiest possible state, within the context of agricultural and economic constraints

Particular attention should be given to the regularity of flow of irrigation runoff. BLM should be aware of any intention to cease irrigation or to increase flow beyond usual levels. In addition, BLM should be aware of all chemical additives, including pesticides and fertilizers, used in the farming operations which have the potential to enter the irrigation runoff and concentrate within the pools of the study area.

5.3 Afton Canyon

Future management of water quality at Afton Canyon should emphasize three factors:

- Maintaining the existing superior water quality

- Preventing recreational activities at the BLM Afton Canyon Campground from producing unnecessary negative impacts on the Mojave River, including the destruction of riparian vegetation, damage to riverbank stability and substrate integrity, and additives to the water

- An awareness of the changing status of water rights and use along the entire course of the Mojave River, particularly in communities upstream from Afton Canyon which are experiencing population growth and industrial development leading to increased removals of water from the watershed and aquifer

Water quality and flow should be monitored on a continuing, seasonal basis to ensure that BLM is aware of any decrease in quality or flow beyond

normal fluctuations. A baseline of data concerning water quality and flow and including seasonal variation will have to be established before a meaningful monitoring program can be instituted.

A public education program aimed at users of the Afton Canyon Campground should be established, including brief pamphlets explaining the need for care in activities involving the Mojave River. BLM personnel at the campground should be instructed to support and enhance this educational effort through their contact with campground users.

A close liason should be maintained between BLM and municipal governments of communities associated with the Mojave River, so that BLM will be cognizant of all trends towards increased drafting of water and potential impacts to water quality. Further communication should exist among BLM, the San Bernardino County Environmental Improvement Agency, and the California Regional Water Quality Control Board, Lahontan Region to develop strategies and coordinate efforts aimed at protecting the quality and flow of the Mojave River throughout its course. The water quality conditions at Afton Canyon can ultimately be protected only through a broad, inter-agency program which involves communities and industries producing impacts to the water.

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APPENDIX A

ANNOTATED BIBLIOGRAPHY

ANNOTATED BIBLIOGRAPHY

Literature Search and Analysis

As reported in the progress letter of December 28, 1978, Tetra Tech identified 59 references which relate to the present investigation. These included books, technical papers, magazine and newspaper articles, government documents, and unpublished academic dissertations. However, none of these citations applied directly and specifically to the present study or study areas; the relationship in each case was indirect or general. While this is unfortunate, it is nevertheless possible to state the following conclusions based on a thorough search of the literature:

- A distinct and identifiable body of data on the hydrography, hydrology, and water quality of the California Desert does not exist.

- No studies specifically relating to the water resources of the San Sebastian Marsh, the Harper Dry Lake area, or Afton Canyon have been identified.

- The present investigation is the only known quantitative study of water resources which has been prepared for the San Sebastian Marsh, the Harper Dry Lake area, or the Mojave River surface flow at Afton Canyon.

The literature search and analysis proceeded according to a step-by-step strategy. The first step was a computerized data base search performed in-house by Tetra Tech. This procedure utilized the Lockheed DIALOG online information system which contains over 80 data bases with access to over 17 million references. A combination of descriptor sets was specified for the search of each data base, limiting the identification of citations to those references which contain or combine the desired descriptors. Descriptor sets used in the literature search were as follows:

- California + desert
- California + desert + water
- California Desert Conservation Area
- Mojave
- San Felipe Creek
- San Sebastian Marsh
- Harpers Well
- Harper Dry Lake
- Afton Canyon

The following data bases were searched for the above descriptor sets:

- BIOSIS (Biological Abstracts): 1969 - October 1978
- Comprehensive Dissertation Abstracts: 1861 - December 1978
- Enviroline: 1971 - October 1978
- Environmental Periodicals Bibliography: 1974 - August 1978
- Federal Index: 1976 - October 1978
- Geoarchive: 1974 - October 1978
- Magazine Index: 1977 - October 1978
- National Technical Information Service: 1964 - December 1978
- Pollution Abstracts: 1970 - December 1977
- SCISEARCH: 1969 - October 1978

Following the identification of citations, abstracts and lists of key words were obtained for all references which applied even remotely to the project subject and study areas, and those references with abstracts clearly relevant to the project were ordered for review.

The second step in the literature search and analysis strategy was the utilization of SCAN: the Southern California Answering Network. This system was activated to search the data bases of major periodicals and newspapers, including the New York Times, the San Francisco Chronicle, the Los Angeles Times, and the San Bernardino Sun-Telegram, for articles relating to the project subject and study areas. Six substantive articles were

obtained through this source, in addition to many notices of meetings of the California Desert Conservation Area Advisory Committee. The six articles are indicated below:

- Cleveland, Jan. 1978. At issue - which history to preserve. San Bernardino Sun-Telegram. September 29.

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The third element of the literature survey strategy involved personal visits to the Pasadena Public Library, the Los Angeles Public Library, the San Bernardino Public Library, the Environmental Sciences Library of the California Institute of Technology, and the Biology-Agriculture Library of the University of California at Riverside. These visits included manual searches of card files and vertical files of newspaper and magazine clippings. Little specific information was obtained by this method; most relevant publications were general textbooks on hydrology, water quality, and water rights. No technical papers or reports specifically relevant to the project subject or study areas were identified.

The fourth step in the literature strategy was the review of all materials obtained through the three preceding steps. The project specialists in biology, hydrology, water quality chemistry, land use, and water rights analysis read and evaluated those books, papers, dissertations, and articles which were directly relevant to their respective fields of expertise. None of the references reviewed was critically useful for document preparation. However, this review did provide helpful background information and insight.

DIALOG Print-Out Sheets

The computerized DIALOG data-base search resulted in a series of citations generally relating to the California Desert but not specifically or directly relevant to the San Sebastian Marsh, the Harper Dry Lake area, or Afton Canyon. These citations and their abstracts are included in the following pages. Many may be of interest to readers of the present study.

APPENDIX B

CONTACTS AND INTERVIEWS

CONTACTS AND INTERVIEWS

The following persons were personally interviewed in their offices during the course of the present series of studies:

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- Mr. Eric Nelson (Interviewed in the field)
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APPENDIX C

INDICATOR BACTERIA

FOR

WATER QUALITY

INDICATOR BACTERIA FOR WATER QUALITY

The indicator bacteria measured in the present investigation were total coliform (TC), fecal coliform (FC), and fecal streptococcus (FS). Densities were determined with respect to 100 milliliters of sampled water, the established volume for standard procedures (1,2,3). While not harmful themselves, these bacteria indicate by their presence that pathogenic viruses, bacteria, or protozoa of intestinal origin may also be present in the sampled water (1,2,3).

Each type of indicator bacteria has its special application. Drinking water standards are based only on TC bacteria because their presence alone opens the possibility of fecal contamination by birds or mammals, including humans (4). However, TC bacteria are universally present in soils, vegetation, and therefore in streams totally free of avian or mammalian fecal contamination. For this reason TC bacteria provide no information concerning either the presence of fecal contamination or its source.

Standards for surface water quality, recognizing the greater specificity of FC bacteria as an indicator type for fecal contamination, establish criteria based on FC rather than the more general TC bacteria (5,6). Unless cultured in the laboratory, FC bacteria live only in the intestines of birds and mammals, and they survive for a much shorter time in water than do other coliforms. Their presence in a water sample therefore provides strong evidence of recent fecal contamination.

Fecal streptococcus (FS) bacteria are also confined to avian and mammalian intestines unless cultured; they provide a confirmation of fecal contamination and can be used with FC bacteria to indicate the likelihood of a human source versus a non-human source such as poultry, livestock, or wildlife (2,3).

The FC to FS ratio is a significant analytical tool resulting from increased use of FS testing in water quality investigations (2). The measured densities of FC and FS bacteria are set in proportion as follows:

$$\frac{\text{FC per 100 milliliters}}{\text{FS per 100 milliliters}} = \text{ratio}$$

The following limitations apply to the construction of this ratio (2):

- The samples must be taken at the same station at the same time, not more than 24 hours downstream from the source of contamination.
- The pH of the sampled water must lie between 4.0 and 9.0.
- Only FC (not TC) can yield a valid ratio.

The value of the ratio, under the stipulated limitations, can indicate the likelihood of human contamination. This is useful because human feces are more likely than non-human wastes to contain pathogens which are dangerous to humans. If the FC count is two or more times the FS count, human pollution is indicated because FC bacteria are more likely to arise in large numbers from human wastes than from the feces of poultry or livestock. By converse, a larger FS count indicates the likelihood of non-human contamination (2).

The following ratio values serve as interpretive guidelines (2):

$\frac{FC}{FS} > 4$: Human pollution is strongly indicated.

$2 < \frac{FC}{FS} < 4$: A predominance of human wastes in mixed pollution may exist.

$1 < \frac{FC}{FS} < 2$: Interpretation is uncertain.

$\frac{FC}{FS} < 1$: A predominance of poultry or livestock pollution is indicated.

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APPENDIX D

DERIVATION OF EQUATION FOR DISSOLVED (FREE) CARBON DIOXIDE

DERIVATION OF EQUATION FOR DISSOLVED (FREE) CARBON DIOXIDE

$$\frac{[H^+]\ [HCO_3^-]}{[H_2CO_3]} \cong \frac{[H^+]\ [HCO_3^-]}{[CO_2]} = K_1$$

Let $K_1 = 10^{-6}\ k$

Therefore: $$\frac{[H^+]\ [HCO_3^-]}{[CO_2]} = 10^{-6}\ k$$

Therefore: $[CO_2] = \frac{1}{k} \cdot 10^6 \cdot [H^+]\ [HCO_3^-]$ (Equation 1)

However: $[H^+] = 10^{-pH}$

Therefore: $[CO_2] = \frac{1}{k}\ [10^{(6-pH)}]\ [HCO_3^-]$ mol/liter (Equation 2)

The following equalities exist:

mol CO_2/liter . 44 mg/mol = mg CO_2/liter

Therefore: mol CO_2/liter = $\frac{1}{44}$ mg CO_2/liter (Equation 3)

mol HCO_3^-/liter · 61 mg/mol = mg HCO_3^-/liter

Therefore: mol HCO_3^-/liter = $\frac{1}{61}$ mg HCO_3^-/liter (Equation 4)

Substituting Equations 3 and 4 into Equation 2:

$[CO_2]$ mg/liter = $\frac{44/61}{k}\ [10^{(6-pH)}]\ [HCO_3^-]$ mg/liter (Equation 5)

(CONTINUED NEXT PAGE)

Or: $[CO_2]$ mg/liter $= \frac{0.72}{k} \cdot 10^{(6-pH)}$ $[HCO_3^-]$ mg/liter

But: $\frac{50}{61}$ $[HCO_3^-]$ mg/liter = $[HCO_3^-]$ mg/liter as $CaCO_3$

Therefore: $[HCO_3^-]$ mg/liter $= \frac{61}{50}$ $[HCO_3^-]$ mg/liter as $CaCO_3$

(Equation 6)

Substituting Equation 6 into Equation 5:

$$[CO_2] \text{ mg/liter} = \frac{61/50 \cdot 44/61}{k} \cdot 10^{(6-pH)} [HCO_3^-] \text{ mg/liter as } CaCO_3$$

$$= \frac{0.88}{k} \cdot 10^{(6-pH)} [HCO_3^-] \text{ mg/liter as } CaCO_3$$

$$= \frac{0.88 \cdot 10^{(6-pH)}}{K_1 \cdot 10^6} \quad \text{(Equation 7)}$$

Since $k = K_1 (10^6)$ as stated above,

$$[CO_2] \text{ mg/liter} = \frac{0.88}{K_1} \cdot 10^{-pH} [HCO_3^-] \text{ mg/liter as } CaCO_3$$

APPENDIX E

DETAILS OF PHYSICAL MEASUREMENTS

DETAILS OF PHYSICAL MEASUREMENTS

Cross-Section and Streamflow

Streamflow was measured after establishing a cross-section in accordance with U.S. Geological Survey (USGS) guidelines (1). A straight channel reach was required without constrictions or obstacles; the banks were as free as possible of erosion; and the flow was without ponding or backwater from downstream tributaries or other sources. Stream velocity and depth determined whether a particular stream location was wadable and therefore suitable for establishing a cross-section.

After the proper location for a cross-section was determined, a plastic tape marked in 0.1 foot intervals was stretched across the stream perpendicular to the flow and anchored securely at each bank. Fifteen to twenty equal increments were chosen and noted on a flow sheet, and stream depth was recorded at each increment to the nearest 0.05 foot. At each vertical in the cross-section discharge measurements were made following USGS criteria (2). Discharge measurements were made using the current-meter method, which consists of determinations of velocity and area in the parts of a stream cross-section. At each vertical, observations are recorded relating the distance to a reference point on the bank, the depth of flow, and the velocity as indicated by the current marked at one or two points in the vertical. Because nearly all verticals were less than 2 feet in depth, the 1-point method was used as outlined in the Water Measurement Manual of the U.S. Bureau of Reclamation (3). Flow

measurements were therefore taken at about six tenths total depth, this depth taken to be the mean velocity in the vertical. The discharge in each partial section was calculated to be the product of mean velocity times depths of the vertical times the sum of half the distances to adjacent verticals. The sum of the discharges in all the partial sections was the total discharge of the stream.

Flow measurements taken by the current meter method involve wading the stream with a current meter which slides on a graduated metal rod and timing the number of revolutions of a bucket wheel set at a predetermined depth (six tenths total depth). The essential features of a current meter are a wheel which rotates when immersed in flowing water and a device to determine the number of revolutions of the wheel. The Price meter and Price pygmy meter used on this survey are cup-type instruments with vertical axes which were developed by USGS. The Price-type meters have the following general features: vanes to keep the wheel headed into the current, a graduated metal rod for handling the meter, a rotor with a vertical axis and six cone-shaped cups, an electrical device for signaling the number of revolutions, and connections from the current meter to a 1 1/2-volt battery-powered headphone. (Because nearly all of the streams on this survey were clear and reasonably slow-flowing, both Price meters had painted cups and a visual count was made of the number of revolutions. In turbid or fast-flowing, wadable water, the earphones were used.) The Price current meter was used to observe velocity, except in shallow depths where the pygmy (2/5 the size of the

Price) meter was used. The pygmy meter, with a bucket wheel 2 inches in diameter compared with 5 inches with the conventional Price meter, is limited to velocities up to 3 or 4 feet per second and is used to supplement the Price meter in shallow areas of a stream. Each meter is individually calibrated in the rating flume at the National Bureau of Standards. After depth, velocity, and time in seconds were recorded total flow was computed for each stream.

Bed Material

Bed material consists of sedimentary material at rest on a stream floor. Stream floor sediments range in size from boulder to silt and clay, but are generally finer than 30 or 40 millimeters in diameter. Particle size is an important textural element of sedimentary material because it is related to the dynamic conditions of transportation and deposition (4). In sampling bed material the size distribution of particles and the quantity of sample determines the equipment used. In analyzing sediments in the lab the most common method of measuring particle size is by sieving.

For this study two pieces of equipment were used to obtain samples. Where the sediment consisted of material smaller than pebble (less than 4 millimeters in diameter) an F.I.A.S.P.-approved bed material sampler, the US BMH-53, was used. For larger material a hand trowel was used.

The US BMH-53 is a hand-held piston-type sampler that was designed to sample material finer than medium gravel from the bed of a wadable stream.

It is 46 inches in total length, tubular in shape, and usually made of corrosion resistant materials. The lower end of the sampler contains a cylinder 2 inches in diameter and 8 inches long which is pressed into the streambed to collect the sample. A handle for pressing the cylinder into the bed is located at the top of the sampler frame. A piston rod with a handle on its upper end passes through the sampler frame to the piston inside the cylinder. The piston is retracted when the cylinder is pressed into the bed material and suction is created by the piston holds the sample in the cylinder. The sample is pushed out of the cylinder by the piston and stored (5).

Bed material samples were collected at several locations in the cross-section across each stream. A sample was taken on each bank, generally within 1 to 3 feet of the water's edge and at the extremes of flow regimes within the channel. After collection by trowel or piston corer, each sample was placed in a plastic zip-loc bag, labelled, and sealed for later analysis in the lab. Approximately four samples were taken from each stream.

Laboratory analysis of bed material samples involved washing the sample into an aluminum tray and drying in a Soiltest oven at 200°F overnight. Samples containing a high percentage of mud were dried at a lower temperature for a longer period of time. Samples high in organic material were weighed and treated with a 3 percent solution of H_2O_2 after oven drying. Approximately 100 milliliters of distilled water and 300 to 400 milliliters of H_2O_2 (depending on the amount of sample) were added to each aluminum tray. These were replaced in the oven at a temperature of 100°F until dry.

After drying the samples were disaggregated with a plastic spoon and weighed on a Sartorius top-loading balance to an accuracy of 0.1 gram. For samples greater than about 250 grams of fine material, sediments were halved using a Sepor portasplitter and reweighed. A sieve analysis was then performed on one of the samples chosen at random.

A sieve analysis is a mechanical separation method whereby a sample of known weight is passed through a nested set of sieves of decreasing mesh size and weighing the amounts retained on each sieve. The grade scale most commonly used for sediments is the Wentworth scale which was established in 1922 and gives descriptive class terms for various sizes of sedimentary particles. The Wentworth is a logarithmic scale in which each grade limit is twice as large as the next smaller limit. The phi ϕ scale was devised by Krumbein and is a logarithmic transformation of the Wentworth grade scale based on the negative logarithm to the base 2 of the particle diameter. A copy of the Wentworth scale and Krumbein's transformation of it is included.

A sieve analysis consisted of a visual inspection of the sample to determine the predominant descriptive class term of the sediment, whether coarse sand, fine sand, silt, etc. Because of the wide range of sizes of material, intervals of 1ϕ were used in most cases. After selecting an appropriate range of U.S. Standard sieves the weighed samples were shaken mechanically for 15 minutes on a Tyler portable sieve shaker. This apparatus shakes six sieves and a pan at one time. These 7 size fractions were then weighed individually to an accuracy of 0.1 gram and

recorded on a data sheet. The total weight of the size fractions was found and the amount of sample lost and its percentage of the total was calculated. In all sieving some sediment is always lost (especially in samples which are predominantly very fine sand or silt), and in most cases this loss was less than 2 percent of the total weight of the original sample. This loss was recorded on each data sheet. Also recorded on the data sheet is the percent by weight of each size fraction and the cumulative percent total by decreasing size.

Bed Load

Bed load is the coarse fraction of suspended sediment in streamflow which slides, rolls, or bounces along in almost continuous contact with the streambed. These particles progress downstream through alternating periods of movement and rest and move within a 0.25 foot zone of the bed. A close relationship exists between the bed load and bed material because while a particle is moving it is part of the bed load; once it stops moving it becomes bed material. The size distribution of bed load, however, is generally finer than that of bed material.

Bed load sediment moves at velocities less than the surrounding flow, these velocities often varying considerably with respect to both space and time. For this reason a bed load sample may not be representative of the entire cross-section for a reasonable interval of time. As stated in *Field Methods for Measurement of Fluvial Sediment*, "the bedload discharge...cannot be determined in the same manner as suspended sediment

loads through computation by use of suspended concentration and water discharge data" (1). For this study only one flow-weighted bed load sample was taken.

To obtain a bed load sample a Helley-Smith bed load sampler was used. This sampler, which is currently under investigation by USGS, is approximately 3 feet long, 65 pounds in weight, and has a 3½ inches in aperture. A 0.25 millimeter mesh nylon triangular-shaped bag fits over the rear of the aperture and is tied to the tail section of the sampler. The Helley-Smith is used in streams where "the median diameter of the bed material (D_{50}) is between 2 and 8 millimeters (very fine to fine gravel), the range of bed material sizes is relatively narrow and bed forms, flow depths, and velocities permit controlled placement and retrieval of the samples" (6).

The Helley-Smith was placed in the stream in a position where a flow-weighted sample could be obtained and where the stream bottom was flat and free from obstruction. A timed sample of from 1 to 5 hours was taken. After removal from the stream the bag was detached and air dried overnight. The sample was removed from the bag by shaking onto a clean flat surface and by brushing with a small paint brush. Storage for the sample was in a labelled zip-loc plastic bag.

Analysis of the Helley-Smith sample involved weighing the sample on a Sartorius top-loading balance to an accuracy of 0.1 gram and digesting organic material in a 3 percent solution of H_2O_2. After oven-drying at 100°F the sample was reweighed and the weight of material transported per unit time was calculated.

Suspended Sediment

Suspended sediment refers to the smaller sediment particles held in suspension by turbulent currents in a stream. In general these particles are distributed uniformly throughout the vertical, the finer sediments moving downstream at about the same velocity as the water. Coarse sediments are found closer to the streambed and are regarded as bed load and unmeasured load. Bed load is the larger material that rolls, skips, and bounces along in almost constant contact with the streambed. Unmeasured load is the sediment which lies above the range of bed load (0.30 foot) and below the range of suspended sediment (0.30 foot). Sampling for material in suspension followed USGS guidelines (1). Samples were taken using an F.I.A.S.P.-approved suspended sediment sampler. Streams too fast flowing to obtain a sample with the US DH-48 had no gauging station or bridge nearby where a heavier sampler, such as the US DH-59, could be used. Slow flowing, shallow streams were measured by immersing the bottle into the stream. These samples were analyzed but gravimetric figures for suspended sediments given in Table 7 are probably more accurate. Only measurements using the ETR method are included in Table 7 under "Suspended Sediments ETR."

The US DH-48 is a lightweight hand sampler weighing 4½ pounds (2 kilograms) consisting of a streamlined aluminum casing 13 inches (33 centimeters) long. A pint glass milk bottle fits underneath the sampler and rests against a rubber gasket at the head of the casing. Water enters the sampler through a calibrated ¼ inch (inside diameter) intake nozzle and is discharged into the bottle. Sampling with the US DH-48 obtains

a sample to within 0.3 foot of the streambed. Below this zone a bed load sampler was used.

After a cross-section was established traversing the stream and flow was measured, a flow-weighted suspended sediment sample was taken. Only one suspended sediment sample was taken because of cost factors and because most streams appeared to have a stable cross-section and a rather uniform lateral suspended sediment distribution. After orientation of the sampler in the stream (at a flow-weighted point), depth integration was accomplished by lowering the sampler to the streambed at a constant or uniform transit rate. The equal transit rate (ETR) method was used whereby the sample was lowered to the streambed and raised at a constant rate and timed.

Generally, the ETR method employs the use of many verticals to obtain suspended sediment-discharge measurements, but cost factors limited the number of suspended sediment samples taken. Flow was measured by other methods.

Primarily, suspended sediment samples were used to determine the amount of suspended material for a given volume of water. Laboratory analysis of each sample employed a variation of the standard filtration technique (7). Instead of a Gooch crucible, the membrane filtration technique was used utilizing the apparatus in Millipore's Field Water Test Kit. This kit consists of a field-sterilization filter holder assembly and a valved syringe used as a vacuum pump. A 0.45 micron 47 millimeter Millipore disc filter was numbered and weighed on a Metler H34 balance

to an accuracy of 0.0001 gram. The filter was subsequently rinsed with distilled water, placed in a plastic petri dish, dried at 100°F in a Soiltest oven for 2 hours and placed in a dessicator overnight. The dried filters were then reweighed and placed on the stainless steel filter holder assembly of the Millipore field water test kit. The suspended sediment samples in the milk bottle were emptied into a graduated cylinder, measured, and the volume was recorded. After emptying into the stainless steel funnel all sample containers and the filter holder assembly were rinsed with distilled water to ensure that all sediment reached the filter. The filter was removed, placed in a petri dish and dried in the oven overnight at 100°F. The filter was again placed in a dessicator overnight. After weighing on the Metler balance, the concentration in milligrams per liter was calculated.

Suspended sediment concentration was determined following USGS guidelines (8). Sediment concentration is the ratio of the weight of the sediment to the volume of water. For suspended sediment samples using the ETR method, sediment concentration is measured in terms of sediment weight per volume of water per unit time.

Turbidity

Turbidity measurements were taken with an HF Instruments (Bolton, Ontario, Canada) DRT-15 portable battery operated turbidimeter. This instrument consists of a small well with a light source, sensor and cap, and a dial readout. The instrument reads the amount of light passing through a sample placed in a glass cuvet and deposited in the well.

After calibrating the turbidimeter with a reference standard supplied with the instrument which is set at 0.12 nephelometric turbidity unit, a sample of stream water was collected from near the bank and placed in a screw-capped glass cuvet. This sample bottle was wiped dry and all fingerprints were removed before placing it in the well and obtaining the reading.

GRAIN SIZE SCALES FOR SEDIMENTS

The grade scale most commonly used for sediments is the Wentworth (1922) scale which is a logarithmic scale in that each grade limit is twice as large as the next smaller grade limit. The scale starting at 1mm and changing by a fixed ratio of 2 was introduced by J. A. Udden (1898), who also named the sand grades we use today. However, Udden drew the gravel/sand bourdant at 1mm and used different terms in the gravel and mud divisions. For more detailed work, sieves have been constructed at intervals $\sqrt[2]{2}$ and $\sqrt[4]{2}$. The ϕ (phi) scale, devised by Krumbein, is a much more convenient way of presenting data than if the values are expressed in millimeters, and is used almost entirely in recent work.

U.S. Standard Sieve Mesh #	Millimeters	Microns	Phi (ϕ)	Wentworth Size Class	
	4096		-12		
	1024		-10	Boulder (-8 to -12ϕ)	GRAVEL
Use	256		- 8		
wire	64		-6	Cobble (-6 to -8ϕ)	
squares	16		-4	Pebble (-2 to -6ϕ)	
5	4		-2		
6	3.36		-1.75		
7	2.83		-1.5	Granule	
8	2.38		-1.25		
10	2.00		-1.0		
12	1.68		-0.75		
14	1.41		-0.5	Very coarse sand	
16	1.19		-0.25		
18	1.00		0.0		
20	0.84		0.25		
25	0.71		0.5	Coarse sand	
30	0.59		0.75		
35	1/2 — 0.50	500	1.0		SAND
40	0.42	420	1.25		
45	0.35	350	1.5	Medium sand	
50	0.30	300	1.75		
60	1/4 — 0.25	250	2.0		
70	0.210	210	2.25		
80	0.177	177	2.5	Fine sand	
100	0.149	149	2,75		
120	1/8 — 0.125	125	3.0		
140	0.105	105	3.25		
170	0.088	88	3.5	Very fine sand	
200	0.074	74	3.75		
230	1/16 — 0.0625	62.5	4.0		
270	0.053	53	4.25		
325	0.044	44	4.5	Coarse silt	MUD
	0.037	37	4.75		
	1/32 — 0.031	31	5.0		
	1/64 0.0156	15.6	6.0	Medium silt	
Analyzed	1/128 0.0078	7.8	7.0	Fine silt	
by	1/256 0.0039	3.9	8.0	Very fine silt	
	0.0020	2.0	9.0		
Pipette	0.00098	0.98	10.0	Clay	
	0.00049	0.49	11.0		
or	0.00024	0.24	12.0		
	0.00012	0.12	13.0		
Hydrometer	0.00006	0.06	14.0		

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DIALOG File68: EPB 74-78/AUG (Item 1 of 2) User2482 20dec78

0710457
Spatial and temporal relationships between two desert shrubs, Atriplex hymenelytra and Tidestromia oblongifolia in Death Valley, California
Mooney, H. A.; Gulmon, S. L.
The Journal of Ecology, 1977 VOL. 65, NO. 3 (November), p. 831
Descriptors: Atriplex hymenelytra; Tidestromia oblongifolia; Shrub, desert; California (Death Valley); Soil water; Somata

0301513
Water, Land, and Environment, Imperial Valley: Law Caught in the Winds of Politics
Taylor, Paul S.
Natural Resources Journal, 1973 VOL. 13, NO. 1 (January), p. 1
Descriptors: California (Imperial Valley); Water| Law; Homestead Act of 1862; Land ownership; Desert Land Act

User2482 Date:20dec78 Time:11:45:28 File: 68

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  3  7608 WATER
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0007360 72-000828
THE DESERT PUPFISH.
BROWN, JAMES H.
SCIENTIFIC AMERICANNOV 1971 V225 N5 P104 (6)
DESCRIPTORS: *WATER TEMPERATURE; *DESERTS; *DRAINAGE; *LAND MISUSE; *CALIFORNIA; *FISH; *ECOSYSTEMS; *ENDANGERED SPECIES-ANIMAL
REVIEW CLASSIFICATION: 21

0113854 76-005127
CALIFORNIA'S PARCHED OASIS,
MORGAN JUDITH; MORGAN NEIL
NATL GEOGRAPHIC, JAN 76, V149, N1, P98 (30)
FEATURE ARTICLE: THE OWENS VALLEY IN SOUTHERN CALIFORNIA IS DISCUSSED AT LENGTH. RESIDENTS PROTESTED VEHEMENTLY WHEN THE LOS ANGELES AQUEDUCT, COMPLETED IN 1913, BEGAN BEARING MOST OF THE OWENS RIVER TO THAT DISTANT CITY. A DECADE LATER, AMID A DROUGHT, SECTIONS OF THE 222 MI CONDUIT WERE SABOTAGED. CONTROVERSY CONTINUES, BUT MANY IN THE VALLEY NOW PRIZE A WAY OF LIFE PRESERVED BY THE CITY'S THIRST. THE WATER FLOWS FROM OWENS VALLEY BY GRAVITY. IT TAKES FUEL OIL TO PUMP ALL OTHER WATER TO SOUTHERN CALIFORNIA. THE ISSUES THAT REMAIN INVOLVE THE INTEGRITY OF NATURE AND THE DIGNITY OF PEOPLE. (33 PHOTOS)
DESCRIPTORS: *CALIFORNIA ; *WATER SUPPLY ; *LOS ANGELES ; *MOJAVE DESERT ; *DROUGHT ; LIFESTYLES ; AMER INDIANS ; SIERRA MOUNTAINS
REVIEW CLASSIFICATION: 16

0110666 76-002105
FLOUTING THE RECLAMATION ACT,
POSS STANLEY
CALIFORNIA STATE COLLEGE,
NATION, NOV 15, 75, V221, N16, P498 (3)
FEATURE ARTICLE: BASICALLY AN IRRIGATED DESERT LYING BETWEEN THE COAST RANGE AND THE SIERRA NEVADA, CALIFORNIA'S CENTRAL VALLEY STRETCHES NEARLY 500 MI NORTH AND SOUTH. THE SOUTHERN HALF OF THE VALLEY, THE SAN JOAQUIN, CONTRIBUTES ROUGHLY HALF THE STATE'S TOTAL CROP PRODUCTION. IT IS BIG BUSINESS AND HIGHLY CENTRALIZED. THE PARADIGM AND EPITOME OF VALLEY AGRICULTURE IS FOUND ON THE WEST SIDE OF THE SAN JOAQUIN. THE TOWNS ARE FEW AND IMPOVERISHED. THE POLITICS OF WATER IN THE VALLEY ARE DESCRIBED. THE RECLAMATION ACT OF 1902 LIMITS THE SUPPLY OF FEDERALLY SUBSIDIZED WATER TO OWNERS OF LESS THAN 160 ACRES. EXCESS LAND MUST BE SOLD AT A PRICE THAT DOES NOT CONSIDER THE AVAILABILITY OF THE SUBSIDIZED WATER, AND OWNERS AND BUYERS MUST LIVE ON THE LAND OR IN THE NEIGHBORHOOD. THE FIRST PROSECUTION EVER PRESSED UNDER THE 1902 ACT, AND GOV. BROWN'S (D-CALIF) HISTORIC FARM LABOR BILL, SIGNED BY STUNNING NONCOINCIDENCE ON THE SAME DAY, JUNE 5, 1975, MAY BE SEEN AS MARKING THE END OF 73 YEARS OF CLASSIC LAISSEZ-FAIRE CAPITALISM. (1 PHOTO)
DESCRIPTORS: *CALIFORNIA ; *WATER RESOURCES DEVELOPMENT ; *WATER LAW ; *SMALL FARMERS ; *LITIGATION, ENV-FED ; LAND RECLAMATION ; POLITICS, ENV-STATE LOCAL ; ECONOMICS, ENV-LAND ; LABOR UNIONS
REVIEW CLASSIFICATION: 16

0109833 *76-001362
FLOOD-HAZARD STUDY-100-YEAR FLOOD STAGE FOR APPLE VALLEY DRY LAKE SAN BERNADINO COUNTY CALIFORNIA,
BUSBY MARK W
USGS REPORT WRI-11-75, JUN 75 (45)
SPECIAL REPORT: THE FLOOD HYDROLOGY OF APPLE VALLEY, CALIF., WAS STUDIED TO DEVELOP THE 100 YEAR FLOOD STAGE FOR APPLE VALLEY DRY LAKE. SINCE NO ADEQUATE HYDROLOGIC OR METEOROLOGICAL DATA WERE AVAILABLE FOR THE BASIN, SYNTHETIC HYDROLOGIC TECHNIQUES WERE USED. THE 100 YEAR FLOOD STAGE WAS ESTIMATED TO BE AT AN ELEVATION OF 2909 FT ABOVE MEAN SEA LEVEL. (1 GRAPH, 3 MAPS, 12 PHOTOS, 7 TABLES)
DESCRIPTORS: *FLOODS ; *CALIFORNIA ; *HYDROLOGY ; *METEOROLOGY ; *DESERTS ; *FLOW MEASUREMENT ; MATHEMATIC MODELS-WATER
REVIEW CLASSIFICATION: 16

0101646 *75-001633
GEOHYDROLOGY OF THE YUMA AREA, ARIZONA AND CALIFORNIA,
OLMSTEAD, F.H. ; LOELTZ O.J.; IRELAN BURDGE
WATER RESOURCES OF LOWER COLORADO RIVER,
GEOLOGICAL SURVEY PROFESSIONAL PAPER 486-H, 1973 (225)
SPECIAL REPORT: THE GEOHYDROLOGY OF THE YUMA AREA, NEAR THE DOWNSTREAM END OF THE COLORADO RIVER BASIN, IN ONE OF THE DRIEST DESERT REGIONS OF NORTH AMERICA IS EXAMINED. TOPICS DISCUSSED INCLUDE: (1) LOCATION OF AREA, HISTORY OF WATER RESOURCES DEVELOPMENT, METHODS OF INVESTIGATION, AND WELL-NUMBERING SYSTEMS; (2) GEOLOGY-GEOMORPHOLOGY, STRATIGRAPHY, AND STRUCTURE; AND (3) GROUNDWATER HYDROLOGY-GROUNDWATER RESERVE, ORIGIN OF GROUNDWATER AND RECHARGE SOURCES, GROUNDWATER MOVEMENT, WATER BUDGETS, ANALOG-MODEL STUDIES, GROUNDWATER TEMPERATURE, AND THE CHEMICAL QUALITY OF GROUNDWATER. APPENDICES INCLUDE RECORDS OF WELLS, SELECTED LOGS OF WATER WELLS, CHEMICAL ANALYSES OF GROUNDWATER, SELECTED PUMPING TESTS, AND MOISTURE INVESTIGATIONS. (8 DIAGRAMS, 10 GRAPHS, 29 MAPS, 12 PHOTOS, NUMEROUS REFERENCES, 21 TABLES)
DESCRIPTORS: *COLORADO RIVER BASIN ; *HYDROLOGY ; *GEOLOGY ; *GROUNDWATER ; *IRRIGATION ; *STORM RUNOFF ; *WATER TEMPERATURE ; *DATA, ENV-WATER ; *WATER CHEMISTRY ; *WATER WELLS ; ARIZONA ; CALIFORNIA
REVIEW CLASSIFICATION: 16

0034286 *74-007841
OFF-ROAD VEHICLES & THE FRAGILE DESERT AMERICAN BIOLOGY TEACHER MAY 74 V36 N5 P294 (11)
STEBBINS, ROBERT C.
OFF-ROAD VEHICLES & THE FRAGILE DESERT AMERICAN BIOLOGY TEACHER MAY 74 V36 N5 P294 (11)
DESCRIPTORS: *PATHOLOGY, ANIMAL; *PATHOLOGY, PLANT; *OFF ROAD VEHICLES; *CALIFORNIA; *EROSION, WATER; *ENV CONSTRAINTS-TRANSPORT
REVIEW CLASSIFICATION: 18

0124474 *77-006464
RURAL LAND SUBDIVIDING: A LESSON FROM THE SOUTHERN CALIFORNIA DESERT,
VAUX, H. J.
US NATL WATER COMMISSION,
AMERICAN INST OF PLANNERS J, JUL 77, V43, N3, P271 (7)
TECHNICAL REPORT: THE PROLIFERATION IN THE SOUTHERN CALIFORNIA DESERT OF VACANT, LEISURE HOME SUBDIVISIONS IS STUDIED, AND ITS FINANCIAL IMPLICATIONS FOR LOCAL GOVERNMENT ARE ANALYZED. THE SUBDIVISIONS REQUIRE MORE SERVICES OF THE LOCAL GOVERNMENT THAN THEY FINANCE. DATA SHOW THAT THE SUBDIVISIONS HAVE YIELDED NET REVENUES TO LOCAL GOVERNMENTS. THIS IS EXPLAINED, IN PART, BY THE WILLINGNESS OF LOT OWNERS TO PAY TAXES DESPITE REDUCTIONS IN LOT VALUES. THE POTENTIAL ECOLOGICAL AND ARCHEOLOGICAL DAMAGE THAT COULD RESULT FROM DEVELOPMENT OF THESE LEISURE HOME SUBDIVISIONS IS CONSIDERED, AND THE RESULTS ARE PRESENTED AS A BASIS FOR FURTHER PLANNING AND DEVELOPMENT RESEARCH. (2 GRAPHS, 1 MAP, 11 REFERENCES)
DESCRIPTORS: *SUBDIVISIONS ; *CALIFORNIA ; *RURAL DEVELOPMENT ; *DESERTS ; *SOCIOECONOMIC IMPACT ASSESS ; MATHEMATIC MODELS-LAND ; REVENUES
REVIEW CLASSIFICATION: 09

0123088 *77-005173
DRAFT ENVIRONMENTAL IMPACT REPORT: GEOTHERMAL PROSPECTING PERMITS W 9369, W 9539, W 9592,
CALIFORNIA STATE LANDS COMMISSION REPORT EIR-211, UNDATED (37)
SPECIAL REPORT: THE CALIFORNIA STATE LANDS DIV. HAS RECEIVED APPLICATIONS FROM THE GETTY OIL CO. AND THE MANAGEMENT ENGINEERING CORP. FOR PERMITS TO PROSPECT FOR GEOTHERMAL RESOURCES IN THE RANDSBURG AREA OF WESTERN SAN BERNARDINO COUNTY. THE COMPANIES HAVE PROPOSED USING SURFACE EXPLORATORY METHODS TO TEST THE SUITABILITY OF THE AREA FOR GEOTHERMAL EXPLOITATION. IF TEST RESULTS WERE AFFIRMATIVE, THREE EXPLORATORY WELLS WOULD THEN BE DRILLED WITH A SINGLE RIG. THE ENVIRONMENT OF THE REGION IS TYPICAL OF THE LOCAL REGIONAL DESERT AREA. NO CULTURAL OR ARCHAEOLOGICAL RESOURCES ARE KNOWN TO EXIST AROUND THE SITE. THE ONLY ADVERSE IMPACTS FROM THE PROJECT WOULD BE A TEMPORARY LOSS OF ABOUT SIX ACRES OF LAND, THE REMOVAL OF VEGETATION DURING ROAD AND DRILL PAD CONSTRUCTION, AND AIR EMISSIONS FROM WELL TESTING, DRILLING, AND VEHICLES. AT THE CONCLUSION OF DRILLING, PADS AND ROADS WILL BE RESEEDED WITH NATIVE VEGETATION IF THE PROJECT IS UNSUCCESSFUL. (3 DIAGRAMS, 3 GRAPHS, 2 TABLES)
DESCRIPTORS: *ENV IMPACT STATEMENT ; *GEOTHERMAL LEASING ; *CALIFORNIA ; *GEOTHERMAL ENERGY EXPLORATION ; *GEOTHERMAL DRILLING ; DESERT PLANTS ; DESERT WILDLIFE ; GROUNDWATER ; WATER ANALYSIS ; HYDROLOGY ; GEOLOGY ; NOISE LEVELS ; COUNTIES ; SEISMOLOGY
REVIEW CLASSIFICATION: 03

0121004 77-003318
ENGINEERING, POLITICAL, AND ECONOMIC EVALUATION OF WATER EXPORTATION-CALIFORNIA TO RENO, NEVADA,
NAUMANN STEVEN
UNIV OF CALIFORNIA, BERKELEY,
PRESENTED AT AWWA 96TH ANNUAL CONF: WATER TECHNOLOGY AND RESEARCH, NEW ORLEANS, JUN 20-25, 76, V2, P22-8 (12)
SURVEY REPORT: THE ENGINEERING, POLITICAL, AND ECONOMIC POSSIBILITIES OF SUPPLYING POTABLE EXTRA-BASIN WATER TO ENCOURAGE URBAN DEVELOPMENT IN THREE DESERT VALLEYS IN NEVADA ARE EXPLORED. BENEFITS OF EXPORTING TRUCKEE RIVER WATERS EXCEED THE COSTS. SUBSCRIBER PAYMENTS WOULD NOT REPAY CONSTRUCTION COSTS OR THE ANNUAL UPKEEP OF THE SYSTEM. THE PROJECT IS INFEASIBLE AT THIS TIME. (1 DIAGRAM, 1 MAP, 19 REFERENCES)
DESCRIPTORS: *NEVADA ; *DESERTS ; *INTERBASIN WATER TRANSFER ; *ECONOMICS, ENV-WATER ; *WATER STORAGE ; PUMPING SYSTEMS ; AWWA CONF PAPER ; COST BENEF ANALYSIS-WATER ; COMPUTER APPLICATIONS ; URBANIZATION
REVIEW CLASSIFICATION: 16

0114738 *76-005938
URBAN WATER DEVELOPMENT AND MANAGEMENT IN ARID ENVIRONMENTS,
UNTERBERG, WALTER ; MIDNLING ANTHONY L.; DRACUP JOHN A.; BULKEY JONATHON W.; WIDMAN GARY L.; TROTT WILLIAM J.; MULVIHILL MICHAEL E.
ROCKETDYNE, CALIF,
NTIS REPORTS PB-242 300/3GI, MAR 31, 75 (169)
SPECIAL REPORT: URBAN WATER DEVELOPMENT AND MANAGEMENT IN ARID AND SEMIARID ENVIRONMENTS WAS APPRAISED BY CASE STUDIES OF KEY HISTORIC WATER DECISIONS IN SIX CITIES. IN EACH CITY ALTERNATIVE SOLUTIONS TO WATER RESOURCE PROBLEMS AND ORGANIZATIONS AND FACTORS THAT AFFECTED THE DECISIONS WERE IDENTIFIED AND RESEARCHED THROUGH INTERVIEWS. THESE DATA WERE INPUTS TO A POLITICAL INTERACTION SIMULATION COMPUTER PROGRAM THAT WAS USED TO MODEL THE DECISION-MAKING PROCESSES. THE DEVELOPMENT OF A GAINING SIMULATION TOOL ENTITLED ''THE WATER GAME'' AS A STRATEGIC ARID URBAN WATER RESOURCES PLANNING TOOL IS DESCRIBED. THE GENERATION AND PRACTICE OF THIS AND OTHER PLANNING TOOLS ARE DISCUSSED.
DESCRIPTORS: *DESERTS ; *URBAN WATER RESOURCES ; *WATER RESOURCES DEVELOPMENT ; *WATER RESOURCES MANAGEMENT ; *DECISION MAKING ; *GAMES ; MATHEMATIC MODELS-WATER ; CALIFORNIA
REVIEW CLASSIFICATION: 16

0129119 *78-004013
DESERTS BLOOM . . . AND WITHER,
BALL NICOLE
ECOLOGIST QUARTERLY, SPRING 78, N1, P20 (12)
SURVEY REPORT: AGRICULTURE IN THE U. S. IS BEING SEVERELY AFFECTED BY WATER SHORTAGES. SUCH IMPORTANT AGRICULTURAL AREAS AS THE HIGH PLAINS REGION (IN TEXAS, NEW MEXICO, OKLAHOMA, COLORADO, NEBRASKA, AND KANSAS) MAY HAVE TO BE TAKEN OUT OF PRODUCTION AS WATER TABLE DEPLETION LIMITS IRRIGATION. TECHNOLOGICAL DEVELOPMENTS FOR EXPLOITING WATER RESOURCES MAY NOT BE ABLE TO KEEP UP WITH THE RATE OF EXPANSION OF IRRIGATION AGRICULTURE IN THE LONG RUN. MANY THIRD WORLD COUNTRIES WITH EXPLODING POPULATIONS ASSUME THAT THE U. S. WILL BE ABLE TO PROVIDE FOOD IN THE FUTURE. TRENDS IN GROUNDWATER DEPLETION SUGGEST THIS WILL NOT BE POSSIBLE. A FEW COUNTRIES SEEKING AGRICULTURAL SELF-SUFFICIENCY OR INCREASED PRODUCTION HAVE TURNED TO THE SAME INTENSIVE WATER USE PRACTICES THAT ARE DRYING UP U. S. AGRICULTURAL LANDS. THE EXTENT OF WATER RESOURCES MUST BE DETERMINED BEFORE HUGE INVESTMENTS ARE MADE IN WATER DEVELOPMENT PROJECTS. ALTERNATIVES TO EXPLOITATION OF GROUNDWATER SHOULD BE CONSIDERED. WATER USE POLICIES MUST TAKE FUTURE GENERATIONS AND EQUITABLE DISTRIBUTION INTO ACCOUNT. (3 GRAPHS, 13 REFERENCES)
DESCRIPTORS: *WATER SHORTAGE ; *AGRICULTURAL LAND ; *IRRIGATION ; *GROUNDWATER ; *WATER WELLS ; *HOT ENVIRONMENTS ; *EROSION, WIND ; *RESERVOIRS ; *DEVELOPING NATIONS ; LIBYA ; EGYPT ; TEXAS ; COLORADO ; CALIFORNIA
REVIEW CLASSIFICATION: 16

0128914 *78-003808
CALIFORNIA: THE STATUS OF THE ENVIRONMENTAL MOVEMENT,
ZIEROLD, JOHN ; GENDLIN FRANCES; ASHBAUGH JOHN; RAIMUNDO JEFFERY; MCDONALD BETTY JO; RUBIN HAL; ERIKSEN MARY ANN
SIERRA CLUB B, JUN 78, V63, N5, P16 (27)
SURVEY REPORT: THE ENVIRONMENTAL MOVEMENT IN CALIFORNIA HAS RECENTLY BEEN CHARACTERIZED BY AN INCREASING NUMBER OF CONFRONTATIONS AMONG INDUSTRY, POLITICIANS, AND ENVIRONMENTALISTS. ISSUES RECEIVING ATTENTION ARE THE DOW CHEMICAL CO.'S PLAN TO BUILD A PETROCHEMICAL PLANT, THE ASSEMBLY BILL PROVIDING FOR PRESERVATION OF FARMLANDS, THE SITING OF LNG STORAGE FACILITIES, THE PRESERVATION OF THE SANTA MONICA MOUNTAINS NEAR LOS ANGELES, THE DESIGNATION OF USBLM DESERT LANDS AS WILDERNESS, AND THE PROMOTION OF THE INTEGRATED PEST MANAGEMENT CONCEPT TO REDUCE PESTICIDE USE. INTERVIEWS WITH CALIFORNIA GOVERNOR JERRY BROWN AND SECRETARY OF RESOURCES HUEY JOHNSON GIVE INSIGHT INTO THE POLITICAL ATTITUDES TOWARDS ENVIRONMENTAL ISSUES. THE CALIFORNIA SENATE AND ASSEMBLY ENVIRONMENTAL VOTING RECORDS ARE DEPICTED BY GEOGRAPHICAL AREA. THE CURRENT SITUATION IS SUCH THAT ENVIRONMENTALISTS MUST CAREFULLY GUARD WHAT GAINS HAVE BEEN ACCOMPLISHED. (2 DIAGRAMS, 9 PHOTOS, 1 TABLE)
DESCRIPTORS: *ENV PROBLEMS, GENERAL ; *CALIFORNIA ; *AGRICULTURAL LAND ; *DESERTS ; *LEGISLATION, ENV-STATE LOCAL ; *POLICY-PLANNING, STATE LOCAL ; *INTEGRATED CONTROL-PESTS ; *MOUNTAINS ; *LIQUEFIED NATURAL GAS ; SIERRA CLUB ; WATER SUPPLY ; NATURAL GAS EXPLOR, OFFSHORE ; AGRICULTURAL CHEMICALS ; LAND USE PLANNING
REVIEW CLASSIFICATION: 07

0125345 78-000493
BILLIONS ARE AT STAKE IN CALIFORNIA AS LAND-WATER FIGHT NEARS END,
LINDSEY ROBERT
NEW YORK TIMES, OCT 8, 77, P1
NEWS FEATURE: IF ENFORCED, A NEW FEDERAL REGULATION WOULD BREAK UP HUGE FARMS ON LAND IN IMPERIAL VALLEY, CALIF., THAT HAS BEEN RECLAIMED FROM DESERTS WITH IRRIGATION WATER IMPORTED FROM 1200 MI AWAY. FARM INTERESTS PLAN TO USE THE IMPENDING STRUGGLE AS A PLATFORM AIMED AT REPEALING THE 1902 STATUTE THAT SETS 160 ACRES AS THE MAXIMUM AMOUNT ONE PERSON CAN FARM ON LAND IRRIGATED BY FEDERAL PROJECTS. THE STAKES RUN INTO BILLIONS OF DOLLARS. (1 MAP, 1 PHOTO)
DESCRIPTORS: *IMPERIAL VALLEY ; *SMALL FARMERS ; *IRRIGATION ; *FED ENV PROGRAMS ; *REGULATIONS, FED
REVIEW CLASSIFICATION: 16

0125312 78-000460
THE DESERT EMPIRE,
SIBLEY GEORGE
HARPERS MAGAZINE, OCT 77, V255, N1529, P49 (16)
COMMENTARY: THERE IS NOT ENOUGH WATER IN PHOENIX AND TUCSON TO MAINTAIN CIVILIZATION AS WE KNOW IT IN PENNSYLVANIA AND ILLINOIS. SOLUTIONS TO THE DEARTH OF WATER IN WESTERN STATES HAVE BEEN THOSE OF THE ENGINEER. TECHNICAL APPROACHES ARE APPLIED TO A PROBLEM REQUIRING MORE BROAD-BASED MEASURES. EXPLOITATION OF THE WEST'S LIMITED AQUIFER IS STILL INSUFFICIENT TO KEEP BEVERLY HILLS SWIMMING POOLS FULL THROUGHOUT THE YEAR. DESPITE LARGE AND PROFITABLE DAM CONSTRUCTION PROJECTS, THE COLORADO RIVER FLOW CANNOT FULFILL THE DEMANDS OF AREA LAND USE PLANNERS. THE DESERT EMPIRE THUS RISKS BECOMING A WASTELAND OF BILLION-GALLON, BILLION DOLLAR AQUEDUCTS CONSIGNED TO RUNNING HALF EMPTY. (1 MAP)
DESCRIPTORS: *COLORADO RIVER ; *DROUGHT ; *DESERTS ; *IRRIGATION ; *DAMS ; *DESALINATION ; *WATER SUPPLY ; ARIZONA ; HOOVER DAM ; GLEN CANYON DAM ; GULF OF CALIFORNIA ; UNITED STATES WEST
REVIEW CLASSIFICATION: 16

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GA390000905 0476344
Observations on stream discharge and competence at Mosaic Canyon, Death Valley, California
BEAUMONT, P; OBERLANDER, TM
Bull Geol Soc Am (Boulder) 82/6 P1695-1698 1971 JRNL CODE: BGSAMI
LANGUAGE: ENGLISH
DESCRIPTORS: SURFACE WATER; FLUVIAL GEOMORPHOLOGY
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 491000; 743000
AUXILIARY DESCRIPTOR CODES: 796300; 004200

GA282000337 0355666
The development of water-supply systems in the arid southwestern United States
BAKER, TL; MINOR, JE; CONNOR, SV
Symp Frontiers Semi-Arid World (Lubbock) CONF. DATES: 14 OCTOBER TO 01 OCTOB NO: 74-0376
P2 1974
LANGUAGE: ENGLISH
DESCRIPTORS: WATER SUPPLY
AUXILIARY DESCRIPTORS: NEW MEXICO; ARIZONA; CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 497000
AUXILIARY DESCRIPTOR CODES: 794500; 795300; 796300; 004200

GA261001725 0342682
Groundwater investigation using uranium isotopes in the Mojave Desertregion
KNAUSS, KG; NARY, QL; KU, TL; STONE, RO
CONF. DATES: 18 NOVEMBER TO 20 NOVEM NO: 74-0262
Abstr Program (Boulder) 6/7 P827-828 1974 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: WATER TRACING TECHNIQUES; ISOTOPE GEOCHEMISTRY
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 490500; 670000
AUXILIARY DESCRIPTOR CODES: 796300; 004200

User2482 Date:20dec78 Time:11:41:21 File: 58

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3	13592	WATER
4	3	1AND2AND3

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Search Time: 0.033 Prints: 3 Descs.: 3

1981254 ARTICLE OATS ORDER#: ED514 34 REFS
INFLUENCES OF SEASONAL-CHANGES IN LEAF MORPHOLOG/ ON WATER-USE EFFICIENCY FOR 3 DESERT BROADLEAF SHRUBS (EN)
SMITH WK; NOBEL PS
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024; UNIV CALIF LOS ANGELES,NUCL MED & RADIAT BIOL LAB,DIV ENVIRONM BIOL/LOS ANGELES//CA/90024
ECOLOGY, V58, N5, P1033-1043, 1977

1628601 ARTICLE OATS ORDER#: DC733 29 REFS
TEMPERATURE AND WATER RELATIONS FOR SUN AND SHADE LEAVES OF A DESERT BROADLEAF, HYPTIS-EMORYI (EN)
SMITH WK; NOBEL PS
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024; UNIV CALIF LOS ANGELES,NUCL MED & RADIAT BIOL LAB,DIV ENVIRONM BIOL/LOS ANGELES//CA/90024
JOURNAL OF EXPERIMENTAL BOTANY, V28, N102, P169-183, 1977

1590320 ARTICLE OATS ORDER#: DA119 14 REFS
WATER RELATIONS OF FLOWERING OF AGAVE DESERTI (EN)
NOBEL PS
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024; UNIV CALIF LOS ANGELES,NUCL MED & RADIAT BIOL LAB,DIV ENVIRONM BIOL/LOS ANGELES//CA/90024
BOTANICAL GAZETTE, V138, N1, P1-6, 1977

1551062 ARTICLE OATS ORDER#: CX651 6 REFS
COMPARISON OF INSITU GAMMA SOIL ANALYSIS AND SOIL SAMPLING DATA FOR MAPPING AM-241 AND PU-239 SOIL CONCENTRATIONS AT NEVADA TEST SITE (EN)
KIRBY JA; ANSPAUGH LR; PHELPS PL; HUCKABAY GW; MARKWELL F; BARNES M
UNIV CALIF,LAWRENCE LIVERMORE LAB/LIVERMORE//CA/9455 ; US ERDA,CTR WATER RESOURCES RES,DESERT RES INST/LAS VEGAS//NV/
IEEE TRANSACTIONS ON NUCLEAR SCIENCE, V24, N1, P587-590, 1977

1514112 ARTICLE OATS ORDER#: CV365 37 REFS
WATER RELATIONS AND PHOTOSYNTHESIS OF A BARREL CACTUS, FEROCACTUS-ACANTHODES, IN COLORADO DESERT (EN)
NOBEL PS
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024; UNIV CALIF LOS ANGELES,DIV ENVIRONM BIOL,NUCL MED & RADIAT BIOL LAB/LOS ANGELES//CA/90024
OECOLOGIA, V27, N2, P117-133, 1977

1386870 ARTICLE OATS ORDER#: CL230 38 REFS
WATER, ELECTROLYTE, AND NITROGEN BUDGETS OF JACKRABBITS (LEPUS-CALIFORNICUS) IN MOJAVE DESERT (EN)
NAGY KA; SHOEMAKER VH; COSTA WR
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024; UNIV CALIF LOS ANGELES,NUCL MED & RADIAT BIOL LAB/LOS ANGELES//CA/90024; UNIV CALIF RIVERSIDE,DEPT BIOL/RIVERSIDE//-CA/92502; BARSTOW UNIFIED SCH DIST/BARSTOW//CA/92311
PHYSIOLOGICAL ZOOLOGY, V49, N3, P351-363, 1976

1369272 ARTICLE OATS ORDER#: CJ868 24 REFS
WATER RELATIONS AND PHOTOSYNTHESIS OF A DESERT CAM PLANT, AGAVE-DESERTI (EN)
NOBEL PS
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024
PLANT PHYSIOLOGY, V58, N4, P576-582, 1976

1119544 MEETING AB OATS ORDER#: BQ176 0 REFS
TEMPERATURE AND WATER RELATIONSHIPS FOR SUN AND SHADE LEAVES OF A DESERT BROADLEAF (HYPTIS-EMORYI TORR) (EN)
SMITH WK; NOBEL PS
UNIV CALIF LOS ANGELES,DEPT BIOL/LOS ANGELES//CA/90024
PLANT PHYSIOLOGY, V57, N5, P104-104, 1976

0383702 ARTICLE OATS ORDER#: U7315 30 REFS
EFFECT OF DECREASING WATER POTENTIAL ON NET CO2 EXCHANGE OF INTACT DESERT SHRUBS (EN)
ODENING WR; STRAIN BR; OECHEL WC
DUKE UNIV,DEPT BOT/DURHAM//NC/27706; UNIV CALIF,DEPT LIFE SCI/RIVERSIDE//CA/92502
ECOLOGY, V55, N5, P1086-1095, 1974

User2482 Date:20dec78 Time:11:37:48 File: 94

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Set Items Description
  1 63869 CALIF?
  2   955 DESERT?
  3 21884 WATER
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Print 4/5/1-9

Search Time:  0.035  Prints:  9  Descs.:  3
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52108534
A COMPARISON OF SALT AND WATER REGULATION IN CALIFORNIA QUAIL LOPHORTYX-CALIFORNICUS AND GAMBELS QUAIL LOPHORTYX-GAMBELII
CAREY C; MORTON M L
COMP BIOCHEM PHYSIOL 39 (1A). 1971 75-101. Coden: CBCPA
Descriptors: PREFERRED HABITAT DESERT REGIONS HEAT STRESS URINE CONCENTRATION
Concept Codes: 07004, *07504, *07508, *10011, 10069, *10618, 12002, *12003, 12008, *13002, *13010, 15504, 17504, *23 10
Biosystematic Codes: 85536

52013234
WATER REPELLENT SOILS FIRE AND ANNUAL PLANT COVER IN A DESERT SCRUB COMMUNITY OF SOUTHEASTERN CALIFORNIA
ADAMS S; STRAIN B R; ADAMS M S
ECOLOGY 51 (4). 1970 696-700. Coden: ECOLA
Descriptors: USA LARREA-DIVARICATA-D PROSOPIS-JULIFLORA-D CERCIDIUM-FLORIDUM-D SPHAERALCEA-EMORYI-D
Concept Codes: *07506, 51502, *52807
Biosystematic Codes: 26260, 26330, 26955

50017786
SUMMER WATER REQUIREMENTS OF DESERT BIGHORN IN THE SANTA-ROSA MOUNTAINS CALIFORNIA USA IN 1965 OVIS-CANADENSIS/
BLONG B; POLLARD W
CALIF FISH GAME 54 (4). 289-296. 1968. Coden: CAFGA
Concept Codes: 00512, 01008, 07003, 07504, 07508, *07518, 13202, 18501
Biosystematic Codes: 85715

User2482 Date:20dec78 Time:11:35:46 File: 55

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2	661	DESERT?
3	10713	WATER
4	3	1AND2AND3

Print 4/5/1-3

Search Time: 0.034 Prints: 3 Descs.: 3

65051440
SPATIAL AND TEMPORAL RELATIONSHIPS BETWEEN 2 DESERT SHRUBS ATRIPLEX-HYMENELYTRA AND TIDESTROMIA-OBLONGIFOLIA IN DEATH VALLEY CALIFORNIA USA
GULMON S L; MOONEY H A
DEP. BIOL. SCI., STANFORD UNIV., STANFORD, CALIF. 94305, USA.
J ECOL 65 (3). 1977 831-838, Coden: JECOA
Language: ENGLISH
Descriptors: SEASONS GROWTH SOIL STOMA REPRODUCTION MOISTURE SOIL WATER
Concept Codes: *07504, *07506, 10011, 10620, 12100, 50528, *51502, *51510, 51512, 52805
Biosystematic Codes: 25555, 25795

63062182
WATER ELECTROLYTE AND NITROGEN BUDGETS OF JACKRABBITS LEPUS-CALIFORNICUS IN THE MOJAVE DESERT CALIFORNIA USA
NAGY K A; SHOEMAKER V H; COSTA W R
PHYSIOL ZOOL 49 (3). 1976 351-363. Coden: PHZOA
Descriptors: PLANT DIET URINE CONCENTRATION FECES
Concept Codes: *07508, 07517, *10011, 10060, 10069, *12002, *13003, *13202, 14001, *14004, *15504
Biosystematic Codes: 11000, 86040

61065751
ALTITUDINALLY COORDINATED PATTERNS OF SOILS AND VEGETATION IN THE SAN-JACINTO MOUNTAINS CALIFORNIA USA
HANAWALT R B; WHITTAKER R H
SOIL SCI 121 (2). 1976 114-124. Coden: SOSCA
Descriptors: WOODLAND CHAPARRAL PINE FOREST DESERT CLAY PRODUCTION CLIMATE PRODUCTIVITY WATER MOVEMENT PH BASE SATURATION
Concept Codes: *07504, *07506, 07517, 10060, 12100, 23001, 51502, *51506, *51510, *52803, *52805, 53500
Biosystematic Codes: 11000, 25000, 25102

61054032
PHYTO ESTROGENS ADVERSE EFFECTS ON REPRODUCTION IN CALIFORNIA QUAIL
LEOPOLD A S; ERWIN M; OH J; BROWNING B
SCIENCE (WASH D C) 191 (4222). 1976 98-100. Coden: SCIEA
Descriptors: LOPHORTYX-CALIFORNICUS DESERT ANNUAL PLANTS FORMONONETIN GENISTEIN WATER GROWTH
Concept Codes: 07504, *07506, *07508, 07517, 10060, 13002, *13202, *16504, *17008, *22020, *22502, *51502, *51510, 51512, 51522
Biosystematic Codes: 11000, 85536

61024717
ENERGY AND NITROGEN BUDGETS OF A FREE LIVING DESERT LIZARD SAUROMALUS-OBESUS
NAGY K A; SHOEMAKER V H
PHYSIOL ZOOL 48 (3). 1975 252-262. Coden: PHZOA
Descriptors: PLANT CALIFORNIA USA METABOLIC WATER AESTIVATION GROWTH LABELED WATER
Concept Codes: *06504, *07508, 07517, *10011, 10060, *12002, *13003, *13202, 51506, 51510
Biosystematic Codes: 11000, 85408

54059753
THE PHYSIOLOGICAL ECOLOGY OF DIVERSE POPULATIONS OF THE DESERT SHRUB SIMMONDSIA-CHINENSIS-D
AL-ANI H; STRAIN B R; MOONEY H A
J ECOL 60 (1). 1972 41-57. Coden: JECOA
Descriptors: CALIFORNIA ARIZONA USA SEASONAL STUDY METABOLISM LEAF WATER POTENTIAL NET PHOTOSYNTHESIS DARK RESPIRATION CARBOHYDRATE CONTENT TEMPERATURE COASTAL HABITAT
Concept Codes: *07504, *07506, 07512, 10068, 10614, 10620, 13002, 13003, 23001, 51000, *51502, *51506, *51508, 51519, *51522
Biosystematic Codes: 25700

User2482 Date:20dec78 Time:11:33:50 File: 5

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2	2200	DESERT?
3	37292	WATER
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Print 4/5/1-6

Search Time: 0.044 Prints: 6 Descs.: 3

THE STUDY OF SUBAERIAL AND SUBAQUEOUS SAND RIPPLES

University of Southern California Los Angeles Dept of Geological Sciences (404284)

Semi-annual progress rept.
AUTHOR: Summers, Herbert J.; Stone, Richard O.
5605K3 Fld: 8G USGRDR6906
29 Feb 68 56p
Rept No: USC-Geology-68-1
Contract: N00014-67-A-0269
Project: NR-388-085
See also semi-annual progress rept. dated 1 Jul 67, AD-681 046. Limited number of copies containing color other than black and white are available until stock is exhausted. Reproductions will be made in black and white only.

Abstract: The report contains a study of subaqueous ripples in the marine environment, but two desert field studies also were undertaken. A dip meter was constructed for measurement of ripple geometry on the sea floor. Because existing current meters are unable to distinguish or record a sudden current reversal, a simple surge meter was devised, constructed, and calibrated. Experimental sediment traps were installed at varying distances above the bottom to obtain an indication of suspended sediment distribution. A series of nine dives were made in the San Pedro Channel, California, during the portion of the subaqueous study covered by this report. All instruments that were developed were tested and in those cases where necessary, calibrated. Collection of data was accomplished on ripple type, ripple geometry, sediment character, surge direction, surge velocity, and the influence of obstructions. Two unique subaerial ripple types were observed at the Kelso Dunes, in the Mojave Desert, California: a mixed-form consisting of light and dark sand at the edge of a dune slip face, and an area of compound ripples that developed in a field of changing wind. (Author)

Descriptors: (*Sand, Transport properties), Underwater, Reviews, Sedimentation, Instrumentation, Water waves, Distribution, Erosion, Deserts, Seacoast, Wind, Sources, Theory

Identifiers: Sand dunes, *Sand ripples, Ripple marks

AD-681 047 CFSTI Prices: PC A04/MF A01

THE STUDY OF SUBAERIAL AND SUBAQUEOUS SAND RIPPLES

University of Southern California Los Angeles Dept of Geology (400120)

Semi-annual progress rept.
AUTHOR: Summers, Herbert J.; Stone, Richard O.
5605K2 Fld: 8G USGRDR6906
1 Jul 67 27p
Rept No: USC-Geology-67-2
Contract: N00014-67-A-0269
Project: NR-388-085

Abstract: The report concerns an investigation of sand ripples on desert dunes. Reasons for this approach included greater probability of appreciable wind and blowing sand during the spring months, more favorable desert temperatures during this interval and a smaller probability of thunderstorms with rain. In addition, the subaqueous studies were delayed until the summer because of warmer water and because during the fall and winter months higher seas may be expected with greater wave energy for moving sediment. (Author)

Descriptors: (*Sand, Transport properties), Underwater, Reviews, Sedimentation, Instrumentation, Water waves, Distribution, Erosion, Deserts, Seacoast, Wind, Temperature, Sources, Theory

Identifiers: Sand dunes, *Sand ripples, Ripple marks

AD-681 046 CFSTI Prices: PC A03/MF A01

Multi-Site Streamflow Simulation of Truckee River, Nevada

Nevada Univ., Reno. Desert Research Inst. (254 875)
AUTHOR: Gupta, V. L.; Fordham, J. W.
A341514 Fld: 8H, 601 GRA17203
Sep 71 46p
Project: OWRR-C-2153(3372), OWRR-C-1105(1582)
Monitor: OWRR-C-2153(3373)(1)
Presented at the IASPS Symposium on Statistical Hydrology, Tucson, Ariz. 31 Aug-2 Sep 71.

Abstract: Simulated monthly streamflow sequences in a six-satellite-station configuration within Tahoe-Truckee river system in California-Nevada, were examined in terms of (a) salient features of methodology, and (b) water budget. Problems encountered include imbalance of water budget, and issues associated with handling non-current historic flow sequences. Study has revealed critical needs for further research in the premise of streamflow synthesis as related to a multi-site situation. These include (i) incorporation of hydrologic water-budget in the rationale for simulation, (ii) more robust statistical techniques for testing adequacy and reliability of simulated sequences, (iii) experimentation with non-Markovian generating schemes, (iv) sample length requirements in relation to the bounds of simulated sequences, and (v) influence of smoothing the parameter estimates.

Descriptors: (*Water resources, Management), (*Stream flow, Mathematical models), River basin development, Statistical analysis, Analog simulation, Markov processes, Sequencing, Nevada, California, Hydrology

Identifiers: *Water budget, Truckee River(Nevada), Monthly variations

PB-204 705 NTIS Prices: PC A03/MF A01

FEDERAL PUBLIC LAND LAWS AND POLICIES RELATING TO INTENSIVE AGRICULTURE. VOLUME IV: WORKING PAPERS: FEDERAL PUBLIC LANDS: ECONOMICS OF FARM SIZE IN WESTERN UNITED STATES

Public Land Law Review Commission, Washington, D.C.
7062D4 Fld: 2B, 13B, 91G, 90J USGRDR7003
Oct 69 438p*
Revision of report dated 30 Apr 69. See also Volume I, PB-188 061. Prepared in cooperation with South Dakota State Univ., Brookings. Agricultural Experiment Station.

Abstract: Contents: What is an adequate income for a farm family; The theory: some simple examples of the effect of output on costs and returns; The homestead in the midwest--is it still adequate; Economics of size of irrigated farms; Economics of size of dryland farms.

Descriptors: (*Agriculture, *Economics), (*Water supplies, *Law), Budgets, Money, Cotton, Potatoes, Costs, Irrigation systems, Deserts, Employment, Production, Arizona, Wyoming, Idaho, Oregon, California, Montana, Washington(State)

Identifiers: Homestead acts

PB-188 064 CFSTI Prices: HC A19/MF A01

THE STUDY OF SUBAERIAL AND SUBAQUEOUS SAND RIPPLES

University of Southern California Los Angeles Dept of Geological Sciences (404284)

Semi-annual progress rept.
AUTHOR: Summers, Herbert J.; Stone, Richard O.
5605K4 Fld: 8G USGRDR6906
23 Aug 68 63p
Rept No: USC-Geology-68-2
Contract: N00014-67-A-0269
Project: NR-388-085
See also Semi-annual progress rept. dated 29 Feb 68, AD-681 047.

Abstract: A 'State of the Art' study is given of the quantitative aspects of ripple formation and movement. Furthermore, additional instrumentation was developed to trace the direction and magnitude of water movements related to strength and period of swell. Further investigation of desert ripples was made and data were gathered on sand ripples on the sea floor, with emphasis on the relationship between ripple wave length and median grain size and of median grain size in ripple troughs and crests to ripple wave length, water depth and ocean wave period. (Author)

Descriptors: (*Sand, Transport properties), Underwater, Reviews, Sedimentation, Instrumentation, Water waves, Distribution, Erosion, Deserts, Seacoast, Sources, Theory

Identifiers: Sand dunes, *Sand ripples, Ripple marks

AD-681 048 CFSTI Prices: PC A04/MF A01

Laboratory Rearing of the Desert Pupfish, 'Cyprinodon macularius'

California State Dept. of Fish and Game, Sacramento.
AUTHOR: Crear, David; Haydock, Irwin
C0835J2 Fld: 6C, 57Z, 52G, 86Q GRAI7312
Sep 70 7p
Monitor: NOAA-73030901-8
Included in Fishery Bull., v69 n1 p151-156 Jan 71.

Abstract: The desert pupfish, Cyprinodon macularius, may be reared in the laboratory for use in the study of embryology, genetics, physiology, and behavior. It is euryhaline (0-70%) and eurythermal (8-44.5C) and may be useful as a bioassay for either freshwater or marine pollutants. In the Salton Sea area of California, the recent introduction of exotic species and the encroachment of civilization have drastically reduced the formerly abundant pupfish populations. Laboratory rearing eliminates the need for continuous exploitation of a rapidly contracting natural population and could supply adequate stocks for sanctuaries, thereby preserving the species from extinction. Laboratory apparatus and conditions are described for maintaining larval and adult pupfish. Parasites and diseases encountered are discussed and successful treatments described. Methods for spawning and rearing the desert pupfish in the laboratory are detailed. These methods may also be applicable to many other species of pupfish that are in danger of extinction. (Author)

Descriptors: (*Fishes, *Laboratory animals), Desert, Environment, Fresh water, Salt water, Bioassay, Water pollution, Aquaculture

Identifiers: Cyprinodon macularius, Colorado River, NOAA

COM-73-10522-08 NTIS Prices: (Order as COM-73-10522)

Study of Subaqueous and Subaerial Sand Ripples

University of Southern California Los Angeles Dept of Geological Sciences (404284)

Final rept. 1 Feb 67-31 Jan 72
AUTHOR: Stone, Richard O.; Summers, Herbert J.
A3755H3 Fld: 8G, 64F GRAI7207
15 Jan 72 293p
Rept No: USC-Geology-72-1
Contract: N00014-67-A-0269-0002
Project: NR-388-085
See also report dated Aug 68, AD-681 048.

Abstract: Sand ripples in the marine and desert environments were studied so that comparisons of ripple structure, studies. Crest sediment of small wavelength oscillation ripples is slightly coarser than the material in the troughs, whereas for megaripples, trough sediment is coarser. Ripple wavelength is a function of grain size. Sediment motion on the sea floor is negligible when the average surge velocity is less than 10 cm/sec, particle motion commences at 18 to 21 cm/sec and is widespread at 27 to 30 cm/sec. Bedload exceeds 80% of the total load and 95% of all transport occurs within 15 cm of the bottom. In the aeolian environment ripple geometry is variable and wavelength is a function of crest grain size. Using tracer sand it was determined that under winds of 15-25 mph, threshold velocities range from 21 to 36 cm/sec, average grain velocity is 0.78 m/min, natural ripples travel at 0.4 cm/min and the rate of sand transport is about 0.4 metric tons/meter width/hour. (Author)

Descriptors: (*Sand, Transport properties), Underwater, Reviews, Oscillation, Sedimentation, Ocean bottom, Water waves, Distribution, Erosion, Deserts, Seacoast, Wind, Theory, California

Identifiers: *Sand ripples, Dunes, Surface waves

AD-736 938 NTIS Prices: PC A13/MF A01

Flood-Hazard Study. 100-Year Flood Stage for Apple Valley Dry Lake, San Bernardino County, California

Geological Survey, Menlo Park, Calif. Water Resources Div.*San Bernardino County Flood Control District, Calif. (409 163)

Final rept.
AUTHOR: Busby, Mark W.
C533212 Fld: 08H, 13B, 48G GRAI7523
Jun 75 45p
Rept No: USGS/WRI-11-75, USGS/WRD-75/049
Monitor: 18
Prepared in cooperation with San Bernardino County Flood Control District, Calif.

Abstract: A study of the flood hydrology of Apple Valley, Calif., was undertaken to develop the 100-year flood stage for Apple Valley dry lake. Synthetic hydrologic techniques were used because no adequate hydrologic or meteorologic data were available for the basin. The 100-year flood stage was estimated to be at an elevation of 2,909.0 feet (886.7 metres) above mean sea level.

Descriptors: *Flood forecasting, *Flood routing, *Apple Valley , Hydrology, Deserts, Water loss, Playas, California

Identifiers: *Synthetic hydrology, San Bernardino County(California), NTISDIGSWR

PB-244 783/7ST NTIS Prices: PC A03/MF A01

An Integrated Study of Earth Resources in the State of California Based on Skylab and Supporting Aircraft Data

California Univ., Berkeley. Space Sciences Lab. (328 950)

Quarterly progress rept.
AUTHOR: Colwell, Robert N.; Nichols, James D.; Bowden, Leonard W.; Chambers, Wes
C2463H1 Fld: 93B GRAI7408
30 Nov 73 15p
Contract: NAS2-7562
Monitor: NASA-CR-136652
Prepared in cooperation with Bureau of Land Management, Riverside, Calif.

California, Resources management, Environment management, Deserts, EREP, Skylab program, Aerial photography, Ecology, Forests, Water resources, Rangelands

Identifiers: NASA

E74-10266 NTIS Prices: PC E02/MF A01

Determination of Aerosol Content in the Atmosphere from ERTS-1 Data

Science Applications, Inc., La Jolla, Calif. (388 862)

Progress rept. no. 6, 7 Jul-6 Sep 73
AUTHOR: Ludwig, Claus B.; Griggs, Michael
C1641D3 Fld: 04A, 48C, 93A GRAI7321
7 Sep 73 11p
Contract: NAS5-21860
Monitor: NASA-CR-133623

Abstract: The author has identified the following significant results. Useful empirical relationships between apparent contrast at the Salton Sea/desert test site and the aerosol content of the atmosphere have been found for MSS 4, 5, and 6. This provides another technique to measure the atmospheric aerosol content, in addition to the method of measuring radiance over water surfaces previously reported. Analysis of desert data has shown, as predicted by theory, that the radiance over high albedo surfaces is insensitive to changes in the aersol content of the atmosphere.

Deserts, California, Aerosols, Atmospheric composition, Earth resources program, Albedo, Radiance, Water

Identifiers: NASA

E73-10947 NTIS Prices: PC A02/MF A01

A Rapid and Highly Sensitive Polarographic Analysis for Arsenic (III) in Drinking Water; Application to Determination of Arsenic in Potable Desert Groundwater Uncovers an Analysis Problem With These Waters

Naval Weapons Center China Lake Calif (403 019)

Technical publication
AUTHOR: Whitnack, Gerald C.; Brophy, Richard G.; Martens, H. H.
C7314F3 Fld: 13B, 7D d7622
May 72 17p
Rept No: NWC-TP-5272
Project: ZR-000-01
Monitor: 18
Includes reprints from Analytica Chimica Acta v48 p123-127 1969 and Science v171 p383-385 Jan 71.
Distribution limitation now removed.

Abstract: A simple, rapid and extremely sensitive single-sweep polarographic method of analysis for arsenic in drinking water is presented. The method will determine as little as 5 ppb arsenic with a relative error of 5-10% of the actual concentration. The method is useful in the examination of well water, spring water, and other drinking waters that contain arsenic in very low quantities (50 ppb or less). The method is shown to give more reliable results on drinking water than the APHA accepted method for arsenic analysis. An accuracy investigation of the APHA method for arsenic in certain types of natural waters showed this method to be unreliable and pointed out an analysis problem on the determination of arsenic in potable desert groundwater. (Author)

Descriptors: (*Water supplies, *Polarographic analysis), Arsenic, Detection, Accuracy, Sensitivity, Deserts, Water wells, California, Voltage, Permissible dosage, Water pollution, Colorimetric analysis, Silver compounds

Identifiers: Arsenic(III) analytic detection, California, Dithiocarbamate/diethyl, Ground water, Mojave desert, Drinking water, Sddc(Silver diethyldithiocarbamate), Silver diethyldithiocarbamate, Trace elements, NTISDODXD

AD-894 934/9ST NTIS Prices: PC A02/MF A01

Use of Skylab Imagery to Assess and Monitor Change in the Southern California Environment

California Univ., Berkeley. Space Sciences Lab.*NASA Earth Resources Survey Program, Washington, D.C. (328 950)

Final rept,
AUTHOR: Colwell, R. N.; Bowden, Leonard W.; Huning, James R.;
C6723J2 Fld: 08F, 93A GRAI7615
31 Dec 74 62p
Rept No: SSL-ser-17-Issue-5
Contract: NAS9-14420
Monitor: NASA-CR-147561
Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Ave., Sioux Falls, S.D. 57198.

Abstract: The author has identified the following significant results. The tectonic framework of the Salton Trough may be seen more clearly than ever before when viewed on Skylab imagery. Structural sketch maps were compiled from each frame of the imagery as photomaps delineating observable lineaments, many being extended beyond their prior ground-evaluated extremities. The study of the San Bernardino Mountains has shown that even by using high resolution Skylab imagery, surrogates must be developed in order to determine the relative age of the geomorphic surfaces which were studied. The most powerful surrogate for age determination was found to be reflectance. Reflectance was a function of age as indicated by the darkness of varnish; the older the surface the darker its signature. A test site at Ivanpah Dry Lake in eastern California was used to determine the environments that were to be isolated. Using the technique described by Tapper for density slice edge enhancement, transmittance values for four areas were extracted from the imagery using a microdensitometer. The silver masking technique of enhancement was used to maximize contrast between the designated entities and their surroundings. It was shown that Skylab imagery is exceedingly useful for assessment of ground water resources, both in terms of spatial distribution and behavior, in remote regions. Arid lands such as the south central Mojave Desert are most amenable to these techniques. The geohydrologic units within the study area are easily delineated by noting geohydrologic barriers such as drainage divides, faults, and lithologic contacts.

Descriptors: *Southern California, Ground water, Arid lands, Mojave Desert(CA), Mountains, Salton Sea(CA), Geological faults, Tectonics, EREP, Skylab program, Spatial distribution, Pattern recognition, Maps, Image enhancement, Image contrast, Reflectance

Identifiers: Image processing, Photogeology, NTISNASA

E76-10315 NTIS Prices: PC A04/MF A01

Irrigation Efficiencies in Producing Calories and Proteins: An Annotated Bibliography

California Univ., Davis. Water Resources Center.*Office of Water Research and Technology, Washington, D.C.
AUTHOR: Rada, Edward L.; Berquist, Richard J.
E0501G3 Fld: 2C, 2D, 6H, 13B, 98C, 98D, 48B, 98H GRAI7806
Feb 75 65p
Rept No: 31
Project: OWRT-A-050-CAL, UCAL-WRC-W-389
Monitor: OWRT-A-050-CAL(1)

Abstract: This annotated bibliography, of 704 references, is an important by-product of our water research project entitled: 'The Economic Efficiency of Water Used to Produce Calories and Protein in California.' The focus of the project is on the use of distributed water for the production of food crops which are eventually converted to human inputs of calories (energy) and proteins (growth-energy). When measured in calorie-protein terms, the questions are raised as to which crops are most nutritious, and which are most efficiently produced relative to distributed water used. This compilation of references represents a thorough search of the literature related to various aspects of these questions.

Descriptors: *Calorific value, *Farm crops, *Proteins, *Irrigation, *Bibliographies, Water consumption, Food, Growth, Nutrition, Water supply, Agriculture, Deserts, Evapotranspiration, Linear programming, Nutritive value, Production, Efficiency, California, Reviews

Identifiers: NTISDIOWRT

PB-275 057/8ST NTIS Prices: PC A04/MF A01

Water Resources Research in the Lower Colorado River Basin, 1972-1976

Nevada Univ. System, Las Vegas. Water Resources Center.**Arizona Univ., Tucson.**California Univ., Los Angeles.*Office of Water Research and Technology, Washington, D.C.*Bureau of Reclamation, Washington, D.C.

Completion rept.
AUTHOR: Cooper, E. Nathan; Lyon, Donna K.; DeCook, K. James; Foster, Kennith E.; Scherer, Charles R.
D1941I1 Fld: 13B, 8H, 68D, 48B, 48G GRAI7710
Aug 76 193p
Contract: DI-14-31-0001-5262
Project: OWRT-X-151(5262)
Monitor: OWRT-X-151(5262)(1)
Sponsored in part by Bureau of Reclamation, Washington, D.C. Prepared in cooperation with Arizona Univ., Tucson, and

Abstract: Current and recent research (1972-1976) concerning water resources in the Lower Colorado River Basin is abstracted and compiled into a bibliography of 283 references. Data were gathered by contacting research personnel and requesting information via questionnaire. The report is indexed by principal investigator, keyword and funding source. In addition, the project descriptions are contained in a computerized data file and easily accessed by contacting the Office of Arid Lands Studies, University or Arizona, Tucson, AZ. The information can be retrieved by keyword, principal investigator, state, funding source and geographic location.

Descriptors: *Water resources, *Colorado River, *Bibliographies, Water pollution, Water supply, Water loss, Evapotranspiration, Irrigation, Hydrology, Mine waters, Snow, Remote sensing, Deserts, Ground water recharge, Arizona, California, Nevada

Identifiers: Lower Colorado River Basin, NTISDIOWRT

PB-263 487/1ST NTIS Prices: PC A09/MF A01

Feed and Food from Desert Environments

California Univ., Berkeley.*Department of Energy. (1092000)
AUTHOR: Bassham, J. A.
E113113 Fld: 2D, 13B, 11H, 98D, 48B GRAI7812
Sep 77 53p
Rept No: CONF-770960-1
Contract: W-7405-ENG-48
Monitor: 18
International workshop on bio-saline research, Kiawah Island, SC, USA, 17 Sep 1977.

Abstract: Research programs on controlled environmental agricultural technology to allow a broad range of conventional and unconventional crops to be grown with very limited supplies of fresh or brackish water are reviewed. The use of water derived from the sea, from saline lakes, or from waste water treatment for crops in arid lands is discussed. Plant breeding programs to improve the nutritional value of food crops and irrigation systems to improve plant productivity are discussed. The production of liquid hydrocarbons and lubricating oils from plant species such as Euphorbic and Jojoba, and the use of leguminous plants such as mesquite (Prosopis juliflora), and other native plants, which thrive in arid regions, as important sources of proteins and carbohydrates are cited as examples of the productive potential of arid lands. 41 references. (ERA citation 03:015879)

Descriptors: *Arid lands, *Farm crops, *Hydrocarbons, *Lubricating oils, *Proteins, Agriculture, Carbohydrates, Biological adaptation, Biosynthesis, Climates, Deserts, Irrigation, Nutrients, Plant breeding, Research programs, Socio-economic factors, Terrestrial ecosystems, Water supply, Biomass, Ecosystems, Energy sources, Lubricants, Organic compounds, Petroleum products, Renewable energy sources

Identifiers: ERDA/510100, ERDA/553000, Jojoba oils, Euphorbic, Jojoba, Prosopis juliflora, NTISDE

LBL-6182 NTIS Prices: PC A04/MF A01

Methane from Algae Grown in Desert Regions of California Using Available Ground Waters

California Univ., Livermore. Lawrence Livermore Lab.*Energy Research and Development Administration. (9500007)
AUTHOR: Ward, R. L.; Jeffries, T. W.; Timourian, H.
E0652K3 Fld: 6C, 21D, 57C, 97K GRAI7807
1977 17p
Rept No: CONF-770727-1
Contract: W-7405-ENG-48
Monitor: 18
Workshop on energy resources conservation, Sacramento, California, USA, 14 Jul 1977.

Abstract: The potential for growing thermophilic filamentous blue-green algae in the California desert is discussed. Filamentous blue-green algae grow well at elevated temperatures under high solar radiation in water containing a wide range of dissolved solids. The physical characteristics of filamentous blue-greens makes them easier and less expensive to harvest than unicellular algae forms and once harvested can be readily converted to methane gas by anaerobic digestion. An artist's concept of the proposal is presented. Various factors involved in such a project are considered. They include: productivity, carbon dioxide sparging, high solar insolation, water, anaerobic digestion, suitability of desert resources, special requirements (including water, nutrients, and sunlight), shallow solar pond system, and cost estimates. (ERA citation 03:000211)

Descriptors: *Algae, *Methane, Anaerobic digestion, Biosynthesis, Carbon dioxide, Cost, Deserts, Production, Solar ponds, Water

Identifiers: ERDA/140504, Ground water, Growth, Plants(Botany), NTISDE

UCRL-79716 NTIS Prices: PC A02/MF A01

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Print 4/5/1-16

Search Time:  0.079   Prints:  16   Descs.:   3
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419835 ORDER NO: 72-26403
GEOLOGY OF THE DEVIL'S PLAYGROUND AREA, EASTERN MOJAVE DESERT, CALIFORNIA. 132 PAGES.
DUNNE, GEORGE CHARLES (PH.D. 1972 RICE UNIVERSITY).
PAGE 1617 IN VOLUME 33/04-B OF DISSERTATION ABSTRACTS INTERNATIONAL.
GEOLOGY

399346 ORDER NO: 72-06111
CONSUMPTION OF PRIMARY PRODUCTION BY A POPULATION OF KANGAROO RATS (DIPODOMYS MERRIAMI) IN THE MOJAVE DESERT. 108 PAGES.
SOHOLT, LARS FREDERICK (PH.D. 1971 UNIVERSITY OF SOUTHERN CALIFORNIA).
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ECOLOGY

396154 ORDER NO: 72-02778
THE ECOLOGY OF ANTS IN THE MOJAVE DESERT: THEIR INTERSPECIFIC RELATIONSHIPS, RESOURCE UTILIZATION AND DIVERSITY. 142 PAGES.
BERNSTEIN, RUTH ANGELETTA (PH.D. 1971 UNIVERSITY OF CALIFORNIA, LOS ANGELES).
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ECOLOGY

369898 ORDER NO: 71-09215
AUTECOLOGY OF THE SIDEWINDER (CROTALUS CERASTES) AT KELSO DUNES, MOJAVE DESERT, CALIFORNIA. 224 PAGES.
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ZOOLOGY

259271 ORDER NO: 65-09165
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LANGER, ARTHUR M. (PH.D. 1965 COLUMBIA UNIVERSITY).
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MINERALOGY

255377 ORDER NO: 65-06552
A GEOLOGIC STUDY OF THE HALLORAN HILLS, CENTRAL MOJAVE DESERT, CALIFORNIA. 291 PAGES.
WARNKE, DETLEF ANDREAS (PH.D. 1965 UNIVERSITY OF SOUTHERN CALIFORNIA).
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213253 ORDER NO: 62-00292
STRUCTURE, METAMORPHISM, AND PLUTONISM IN THE EL PASO MOUNTAINS, MOJAVE DESERT, CALIFORNIA. 208 PAGES.
CHRISTIANSEN, ROBERT LORENZ (PH.D. 1961 STANFORD UNIVERSITY).
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GEOLOGY

122627 ORDER NO: NOT AVAILABLE FROM XEROX UNIVERSITY MICROFILMS
I. GEOLOGY OF THE WILDROSE AREAS, PANAMINT RANGE, CALIFORNIA. II. GEOCHRONOLOGIC STUDIES IN THE DEATH VALLEY - MOJAVE DESERT REGION.
LANPHERE, MARVIN ALDER (PH.D. 1962 CALIFORNIA INSTITUTE OF TECHNOLOGY).
GEOLOGY

116348 ORDER NO: NOT AVAILABLE FROM XEROX UNIVERSITY MICROFILMS
AN ANALYSIS OF THE LIVELIHOOD PATTERN OF THE MOJAVE DESERT.
GARRISON, JURAL JEANNE (PH.D. 1960 UNIVERSITY OF CALIFORNIA, LOS ANGELES).
GEOGRAPHY

619909 ORDER NO: 78-21353
THE DIGITAL USE OF LANDSAT DATA FOR INTEGRATED LAND RESOURCE SURVEY: A STUDY IN THE EASTERN MOJAVE DESERT, CALIFORNIA. 277 PAGES.
HUTCHINSON, CHARLES FREDERICK (PH.D. 1978 UNIVERSITY OF CALIFORNIA, RIVERSIDE).
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PHYSICAL GEOGRAPHY

581918 ORDER NO: 77-29475
GEOPHYSICAL INVESTIGATIONS IN SOUTHEASTERN MOJAVE DESERT, CALIFORNIA. 187 PAGES.
ROTSTEIN, YAIR (PH.D. 1974 UNIVERSITY OF CALIFORNIA, RIVERSIDE).
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GEOPHYSICS

522866 ORDER NO: 76-02514
A COMPARATIVE STUDY OF ACHIEVEMENT AND ATTITUDE CHANGES AS A RESULT OF INDIVIDUALIZED AND NONINDIVIDUALIZED MATHEMATICS TEACHING METHODS IN THE SEVENTH, EIGHTH, AND NINTH GRADES IN ROSAMOND AND MOJAVE, CALIFORNIA. 159 PAGES.
HORVATH, MATTHEW JOHN, JR. (PH.D. 1975 UNITED STATES INTERNATIONAL UNIVERSITY).
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EDUCATION, CURRICULUM AND INSTRUCTION

519303 ORDER NO: 75-28620
COMPETITIVE AND INTERACTIVE MECHANISMS AMONG COLONIES OF THE HARVESTER ANT POGONOMYRMEX CALIFORNICUS IN THE MOJAVE DESERT, CALIFORNIA. 110 PAGES.
DE VITA, JOSEPH MICHAEL (PH.D. 1975 UNIVERSITY OF SOUTHERN CALIFORNIA).
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BIOLOGY

518676 ORDER NO: 75-26994
A CONSERVATION AND LAND USE PLAN FOR THE EASTERN MOJAVE DESERT, CALIFORNIA. 170 PAGES.
SWARTS, STANLEY WAYNE (PH.D. 1975 UNIVERSITY OF CALIFORNIA, LOS ANGELES).
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PHYSICAL GEOGRAPHY

498774 ORDER NO: 75-08465
GEOPHYSICAL INVESTIGATIONS IN SOUTHEASTERN MOJAVE DESERT, CALIFORNIA. 188 PAGES.
ROTSTEIN, YAIR (PH.D. 1974 UNIVERSITY OF CALIFORNIA, RIVERSIDE).
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482828 ORDER NO: 74-23968
TOPICS IN MOJAVE SYNTAX. 348 PAGES.
MUNRO, PAMELA ELIZABETH LANG (PH.D. 1974 UNIVERSITY OF CALIFORNIA, SAN DIEGO).
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LANGUAGE AND LITERATURE, LINGUISTICS

477317 ORDER NO: 74-17359
PETROLOGY AND DEPOSITIONAL HISTORY OF LATE-PRECAMBRIAN - CAMBRIAN QUARTZITES IN THE EASTERN MOJAVE DESERT, SOUTHEASTERN CALIFORNIA. 211 PAGES.
LOBO, CYRIL FRANCIS (PH.D. 1974 UNIVERSITY OF SOUTHERN CALIFORNIA).
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GEOLOGY

445376 ORDER NO: 73-18633
RELOCATION OF UNITED STATES HIGHWAY-66, MOJAVE DESSERT, CALIFORNIA. 204 PAGES.
JOSIF, DONALD WILLIAM (PH.D. 1973 UNIVERSITY OF CALIFORNIA, LOS ANGELES).
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GEOGRAPHY

436537 ORDER NO: 73-10407
SETTLEMENT PATTERN OF THE EASTERN MOJAVE DESERT. 307 PAGES.
BARD, ROBERT CHARLES (PH.D. 1972 UNIVERSITY OF CALIFORNIA, LOS ANGELES).
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GEOGRAPHY

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1 19 MOJAVE

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203656 fr 78/07/24 P31991 32FR13938
DOI-BIA: certifies ordinance governing sale, purchase, possession & consumption of alcoholic beverage on Fort Mojave Indian Reservation
Arizona Bureau of Indian Affairs Population, American Indian Alcohol & Drug Abuse Programs agency notices health programs

199183 cr e 78/06/26 P3461 HR13282
Brown CA: intros bill to establish Mojave National Park in California; to Interior
California House of Representatives-Members Forests & Parks Park Programs public bills resources programs

0188846 wp e 78/05/06 P19
DOE: $120mil solar energy experiment will put 2,000 sun-tracking mirrors in Mojave Desert by 1981
Dept of Energy Solar Energy R&D Energy R&D Programs-Solar news expend for R&D

0183194 fr 78/04/07 P14745
DOI-BLM: receives DOD notice of proposed withdrawal of 314,809 acres within Mojave B Range, San Bernardino, California
California Bureau of Land Management Land Use NEC requests received land use, purchase

165730 fr 77/12/12 P62431
DOI-BIA: issues plan to distribute judgment funds awarded Mojave Tribe & Saginaw, Swan Creek & Black River bands of Chippewa
Bureau of Indian Affairs Population, American Indian Indian Land Grants & Claims agency notices land use, purchase

126253 cr h 77/04/19 P3260 HJRes394
Pettis: intros res to authorize DOI to continue providing Fed hydroelectric pwr benefits to Needles, CA, & Mojave Indian Tribe; to Int
California House of Representatives-Members Hydroelectric Construction Hydroelectric Projects public bills constructn expend

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1 6 MOJAVE

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76-03384
Ground-water quality in Indian Wells Valley, California.
WARNER, J.W.
USGS, Water Resources Div., 345 Middlefield Rd., Menlo Park, CA 94025
U.S. Geological Survey. Water-Resources Investigations 8-75. June 1975. 70pp. Publ.Yr: 75
Languages: E
Descriptors: INDIAN WELLS VALLEY; MOJAVE DESERT; CALIFORNIA; GROUNDWATER; HYDROLOGY; RESOURCE MANAGEMENT; WATER QUALITY MEASUREMENTS; WATER RESOURCES

75-03138
Characterization of California aerosols--II. Aerosol size distribution measurements in the Mojave Desert.
CLARK, W.E.; SVERDRUP, G.M.; WHITBY, K.T.
Univ. of Minnesota, Dept. of Mechanical Engineering.; Particle Technology Lab., Minneapolis, MN 55455
Atmospheric Environment, 9(5): 483-494, May 1975. Publ.Yr: 75
Descriptors: MOJAVE DESERT; AEROSOLS; AIR POLLUTION MEASUREMENTS; CALIFORNIA; CHEMICAL ANALYSIS; PARTICLE SIZES

71-00201
Arsenic in potable desert groundwater: An analysis problem.
WHITNACK, G. C.; MARTENS, H. H.
U. S. Naval Weapons Center, Michelson Lab., China Lake, CA
Science, 171(3969): 383-385, Jan. 29, 1971. Publ.Yr: 71
Descriptors: CALIFORNIA; ARSENIC; GROUND WATER; POTABLE WATER; SILVER DIETHYLDITHIOCARBAMATE METHOD; MOJAVE DESERT; MONITORING SYSTEMS

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0403999
Climates and Vegetation Pattern across the Mojave/Great Basin Desert Transition of Southern Nevada
Beatley, Janice C.
American Midland Naturalist, 1975 VOL. 93, NO. 1 (January), p. 53
Descriptors: Nevada (Southern); Climate; Vegetation pattern; Mojave/Great Basin Desert

0401687
Phenological events and their environmental triggers in Mojave Desert ecosystems
Beatley, Janice C.
Ecology, 1974 VOL. 55, NO. 4 (Summer), p. 856
Descriptors: Phenology; Environment; Ecosystem; Mojave Desert

0316723
Mojave Spring
Castagnetto, Stephen
Sierra Club Bulletin, 1974 VOL. 59, NO. 6 (June), p. 17

0316298
Effects of rainfall and temperature on the distribution and behavior of Larrea tridentata (creosote-bush) in the Mojave Desert of Nevada
Beatley, Janice C.
Ecology, 1974 VOL. 55, NO. 2 (Early Spring), p. 245

0315862
Some Effects of Off-Road Vehicles and Sheep Grazing on Lizard Populations in the Mojave Desert
Bury, R. Bruce; Busack, Stephen D.
Biological Conservation, 1974 VOL. 6, NO. 3 (July), p. 179

0313785
Mojave Desert Diary
Breed, Allen F.
Parks & Recreation, 1974 VOL. IX, NO. 9 (September), p. 40

0305686
Sodium Relations in Desert Plants: 1. Cation Contents of Some Plant Species from the Mojave and Great Basin Deserts
Hale, V. Q.; Romney, E. M.; Wallace, A.
Soil Science, 1973 VOL. 115, NO. 4 (April), p. 284

0712443
Frequency Distribution of Lithium in Leaves of Lycium andersonii
Alexander, G. V.; Wallace, A.; Romney, E. M.; Kinnear, J.
Communications in Soil Science and Plant Analysis, 1977 VOL. 8, NO. 9, p. 799
Descriptors: California (Mojave Desert); Frequency distribution; Lithium; Lycium andersonii, leaf; Soil science

0707302
Density and diversity in Mojave Desert rodent and shrub communities
Hafner, Mark S.
Journal of Animal Ecology, 1977 VOL. 46, NO. 3 (October), p. 925
Descriptors: Competition; Seed abundance; Density; Diversity ; Shrub community; Mojave Desert; Habitat; Rainfall

0707058
Power From The Tower
Conservation News. 1977 VOL. 42, NO. 21 (November 1), p. 2
Descriptors: Conservation; Solar energy; Mojave Desert; Thermal energy; Heliostat

0607674
Factors Affecting Seed Reserves in the Soil of a Mojave Desert Ecosystem, Rock Valley, Nye County, Nevada
Nelson, James F.; Chew, Robert M.
American Midland Naturalist, 1977 VOL. 97, NO. 2 (April), p. 300
Descriptors: Mojave Desert, ecosystem; Nevada (Nye County, Rock Valley); Seed reserve; Soil

0521308
Sodium Relations in Desert Plants: 5. Cation Balance When Grown in Solution Culture and in the Field in Three Species of Lycium from the Northern Mojave Desert
Wallace, A.; Ashcroft, R. T.
Soil Science, 1976 VOL. 122, NO. 1 (July), p. 48
Descriptors: Botany; California (Mojave Desert, Northern); Sodium relations; Desert plants; Cation balance; Solution culture; Lycium; Soil science

0512381
A Comparison of Seasonal Primary Production of Mojave Desert Shrubs During Wet and Dry Years
Kleinkopf, Gale E.; Bamberg, Samuel A.; Ackerman, Thomas L.; Vollmer, Arthur T.
American Midland Naturalist, 1976 VOL. 95, NO. 2 (April), p. 398
Descriptors: Botany; California; Shrubs; Climate, wet and dry; Primary production, seasonal, comparison; Mojave Desert; Root biomass

0505769
Seed Treatment of Mojave Desert Shrubs
Graves, W. L.; Kay, B. L.; Williams, W. A.
Agronomy Journal, 1975 VOL. 67, NO. 6 (November-December), p. 773
Descriptors: California (Mojave Desert); Seed treatment; Shrubs

0501713
Comparative photosynthetic production of Mojave Desert shrubs
Wallace, A.; Vollmer, A.; Bamberg, S. A.; Kleinkopf, G. C.
Ecology, 1975 VOL. 56, NO. 3 (Late Spring), p. 732
Descriptors: California (Mojave Desert); Photosynthetic production, comparative; Shrub

0411522
Characterization of California aerosols--II, Aerosol size distribution measurements in the Mojave Desert
Whitby, K. T ; Clark, W. E.; Sverdrup, G. M.
Atmospheric Environment/An International Journal, 1975 VOL. 9, NO. 5 (May), p. 483
Descriptors: Aerosol size distribution; Measurement; Mojave Desert; California

0405226
Quantitative studies of roots of perennial plants in the Mojave Desert
Bamberg, S. A.; Cha, J. W.; Wallace, A.
Ecology, 1974 VOL. 55, NO. 5 (Late Summer), p. 1160
Descriptors: Botany; California (Mojave Desert); Quantitative studies; Root; Plant, perennial; Ecology

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1 17 MOJAVE

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0103312 *75-003261
DISSOLVED ORGANIC CARBON (DOC), AN INDEX OF ORGANIC CONTAMINATION IN GROUND WATER NEAR BARSTOW, CALIFORNIA.
HUGHES, JERRY L. ; ECCLES LAWRENCE A.; MALCOLM RONALD L.
USGS, CALIF.
GROUND WATER, SEP-OCT 74, V12, N5, P283 (8)
TECHNICAL REPORT: THE ALLUVIAL AQUIFER UNDERLYING AND ADJACENT TO THE MOJAVE RIVER NEAR BARSTOW, CALIF., HAS BEEN SUBJECTED TO DEGRADATION FROM PERCOLATION OF INDUSTRIAL AND MUNICIPAL WASTES FOR MORE THAN 60 YEARS. EFFLUENTS DISCHARGED TO THE AQUIFER HAVE CONTAINED HIGH CONCENTRATIONS OF BOTH ORGANIC AND INORGANIC SUBSTANCES. THE CONCENTRATION OF DISSOLVED ORGANIC CARBON, AS DETERMINED BY A WET COMBUSTION TECHNIQUE, HAS BEEN SHOWN TO BE A DEFINITIVE PARAMETER IN IDENTIFYING GROUNDWATER AFFECTED BY WASTE DISPOSAL. DOC CONCENTRATIONS RANGED FROM 0.1-0.8 ML/L IN THE NONDEGRADED GROUNDWATER, AND EXCEEDED 6 ML/L IN THE GROUNDWATER AFFECTED BY THE WASTE DISCHARGE. THE GENERAL DOC DISTRIBUTION IN THE DEGRADED GROUNDWATER HAS BEEN DEFINED BOTH AREALLY AND VERTICALLY. A COMPARISON OF THE AREAL DISTRIBUTION OF DOC AND DETERGENTS SUGGESTS THAT SOME ORGANIC COMPOUNDS MAY HAVE BEEN ABSORBED BY THE AQUIFER SEDIMENTS. (2 GRAPHS, 3 MAPS, 6 REFERENCES, 1 TABLE)
DESCRIPTORS: *GROUNDWATER ; *CALIFORNIA ; *DISSOLVED ORGANIC CARBON ; *AQUIFERS ; *PERCOLATION ; *MUNICIPAL SEWAGE ; *ORGANIC WASTES ; *SEDIMENT ; *DETERGENTS & SOAPS ; *ADSORPTION
REVIEW CLASSIFICATION: 19

0102413 75-002381
THE DESERT SANCTUARY OF JOSHUA TREE.
NYERGES CHRISTOPHER J.
NATL PARKS & CONSERVATION MAGAZINE, NOV 74, V48, N11, P4 (5)
FEATURE ARTICLE: A JOURNEY THROUGH THE JOSHUA TREE NAT'L MONUMENT, CALIF., SHEDS LIGHT ON THE VARIETY AND BEAUTY OF DESERT PLANTS, INCLUDING THE CREOSOTEBUSH, THE MOJAVE YUCCA, AND THE JOSHUA TREE. NPS POLICY PERMITS THE GATHERING OF FRUITS FOR CONSUMPTION WITHIN NATIONAL PARKS AND MONUMENTS, BUT FORAGING THAT WOULD DESTROY ANY PLANT IS NOT ALLOWED. (9 PHOTOS)
DESCRIPTORS: *MONUMENTS, NATL ; *DESERT PLANTS ; *CALIFORNIA ; *CACTUS
REVIEW CLASSIFICATION: 15

0100994 75-000995
SOME EFFECTS OF OFF-ROAD VEHICLES AND SHEEP GRAZING OF LIZARD POPULATIONS IN THE MOJAVE DESERT.
BUSACK, STEPHEN D. ; BURY R. BRUCE .US FISH AND WILDLIFE SERVICE.
BIOLOGICAL CONSERVATION, JUL 74, V6, N3, P179 (5)
RESEARCH REPORT: THE EFFECTS OF OFF-ROAD VEHICLES AND SHEEP GRAZING IN THE MOJAVE DESERT ARE DETERMINED USING THE NUMBERS AND BIOMASS OF LIZARDS AS INDICATORS. SHEEP GRAZING REDUCES GROUND COVER AND THE VEHICLES ELIMINATE VEGETATION, BOTH OF WHICH ADVERSELY AFFECT LIZARD POPULATIONS. PROLONGED SUBJECTION OF DESERT LANDS TO THESE USES MAY IRREPARABLY DAMAGE WILDLIFE COMMUNITIES. (3 PHOTOS, 2 TABLES)
DESCRIPTORS: *LIZARDS ; *MOJAVE DESERT ; *OFF ROAD VEHICLES ; *DESERT WILDLIFE ; *OVERGRAZING ; *SHEEP ; *DESERT BIOME ; *BIOMASS
REVIEW CLASSIFICATION: 21

0029428 74-002645
OFF-ROAD VEHICLES, COMPROMISE PLAN FOR THE CA. DESERT.
CARTER, LUTHER J.
SCIENCE FEB 1, 74 V183 N4123 P396 (4)
DESCRIPTORS: LAND USE CLASSIFICATION; *LITIGATION, ENV-FED; *U S BUR LAND MANAGEMENT; *MOJAVE DESERT; *SIERRA CLUB; *OFF ROAD VEHICLES
REVIEW CLASSIFICATION: 09

0005264 71-005342
MOJAVE DESERT A TREASURE IN TROUBLE.
SELBY, EARAL; SELBY, MIRIAM
NATIONAL WILDLIFE OCT-NOV 1971 V9 N6 P52 (6)
DESCRIPTORS: *CALIFORNIA; *DESERTS; *RESOURCE MANAGEMENT; *ALL TERRAIN VEHICLES; *OPEN SPACE; *SCENIC PRESERVATION; *LAND MISUSE; *LAND USE PLANNING
REVIEW CLASSIFICATION: 09

0123161 77-005246
THE IMPACT OF OFF-ROAD VEHICLES ON A DESERT ECOSYSTEM,
VOLLMER, A. T. ; MAZA B. G.; MEDICA P. A.; TURNER F. B.; BAMBERG S. A.
UNIV OF CALIFORNIA, LOS ANGELES,
ENV MANAGEMENT, 1976, V1, N2, P115 (15)
RESEARCH REPORT: THE EFFECTS OF OPERATING A FOUR-WHEEL DRIVE TRUCK ON 9 HA OF THE MOJAVE DESERT ARE EVALUATED. SPRING DENSITIES OF ANNUAL PLANTS IN RUTS OF A REGULAR TRACK ARE LESS THAN THOSE IN CONTROL AREAS, BUT DENSITIES IN RANDOMLY DRIVEN PLOTS DO NOT DIFFER SIGNIFICANTLY FROM CONTROLS. SEVERITY OF DAMAGE TO SHRUBS IS DIRECTLY RELATED TO INTENSITY OF DRIVING IN THE AREA. (1 DIAGRAM, 1 GRAPH, 5 PHOTOS, 39 REFERENCES, 13 TABLES)
DESCRIPTORS: *MOJAVE DESERT ; *OFF ROAD VEHICLES ; *DESERT ECOSYSTEMS ; *DESERT PLANTS ; *DESERT WILDLIFE ; RODENTS ; LIZARDS
REVIEW CLASSIFICATION: 09

0113854 76-005127
CALIFORNIA'S PARCHED OASIS,
MORGAN JUDITH; MORGAN NEIL
NATL GEOGRAPHIC, JAN 76, V149, N1, P90 (30)
FEATURE ARTICLE: THE OWENS VALLEY IN SOUTHERN CALIFORNIA IS DISCUSSED AT LENGTH. RESIDENTS PROTESTED VEHEMENTLY WHEN THE LOS ANGELES AQUEDUCT, COMPLETED IN 1913, BEGAN BEARING MOST OF THE OWENS RIVER TO THAT DISTANT CITY. A DECADE LATER, AMID A DROUGHT, SECTIONS OF THE 222 MI CONDUIT WERE SABOTAGED. CONTROVERSY CONTINUES, BUT MANY IN THE VALLEY NOW PRIZE A WAY OF LIFE PRESERVED BY THE CITY'S THIRST. THE WATER FLOWS FROM OWENS VALLEY BY GRAVITY. IT TAKES FUEL OIL TO PUMP ALL OTHER WATER TO SOUTHERN CALIFORNIA. THE ISSUES THAT REMAIN INVOLVE THE INTEGRITY OF NATURE AND THE DIGNITY OF PEOPLE. (33 PHOTOS)
DESCRIPTORS: *CALIFORNIA ; *WATER SUPPLY ; *LOS ANGELES ; *MOJAVE DESERT ; *DROUGHT ; LIFESTYLES ; AMER INDIANS ; SIERRA MOUNTAINS
REVIEW CLASSIFICATION: 16

0106771 75-006630
CHARACTERIZATION OF CALIFORNIA AEROSOLS-II. AEROSOL SIZE DISTRIBUTION MEASUREMENTS IN THE MOJAVE DESERT,
SVERDRUP, G. M. ; WHITBY K. T.; CLARK W. E.
UNIV OF MINNESOTA,
ATMOSPHERIC ENV, MAY 75, V9, N5, P483 (12)
RESEARCH REPORT: AEROSOL MEASUREMENTS OBTAINED AT GOLDSTONE IN THE MOJAVE DESERT, CALIF., ARE ANALYZED. THE LOWEST VOLUMES EVER RECORDED WITH THE AEROSOL ANALYZING SYSTEM ARE OBTAINED. LOW NUCLEI CONCENTRATIONS OF LESS THAN 100 CM-3 MAY HAVE OCCURRED BECAUSE OF HIGH ALTITUDE AIR THAT WAS BROUGHT DOWN TO THE EARTH'S SURFACE. TYPICAL BACKGROUND DESERT CONDITION IS A TOTAL VOLUME ON THE ORDER OF 8-13 CM-3. (1 GRAZING IN THE MOJAVE DESERT ARE DETERMINED USING THE NUMBERS DIAGRAM, 6 GRAPHS, 1 MAP, 5 TABLES)
DESCRIPTORS: *AEROSOLS ; *MOJAVE DESERT ; *AIR SAMPLING ; *DATA, ENV-AIR ; *AIR POLLUTION INSTRUMENTS
REVIEW CLASSIFICATION: 01

0104909 75-004825
A LIMNOLOGICAL STUDY OF SILVERWOOD LAKE: IMPACT OF WATER TRANSPORT ON WATER QUALITY,
KUBOMOTO, ROD ; MILLER JIM; WORTHINGTON RON
CALIFORNIA STATE POLYTECHNICAL UNIV,
AWWA J, NOV 74, V66, N11, P663 (5)
TECHNICAL REPORT: SILVERWOOD LAKE, NEAR THE HEADWATERS OF THE WESTERN FORK OF THE MOJAVE RIVER, WAS CREATED AS A MULTIPURPOSE RESERVOIR WHEN STATE AGENCIES REALIZED THE MAJOR NEED FOR MORE RECREATIONAL AREAS IN SOUTHERN CALIFORNIA. THE ENTIRE BIOLOGIC CONDITION AT THE LAKE IS CONSIDERED TO BE REMARKABLY WELL STABILIZED. ' NO MAJOR DETRIMENTS FROM WATER IMPORTATION ARE OBVIOUS, AND EFFECTS OF RECREATIONAL USE OF THE RESERVOIR ARE NEGLIGIBLE. (2 GRAPHS, 2 MAPS, 3 TABLES)
DESCRIPTORS: *CALIFORNIA ; *RESERVOIRS ; *LIMNOLOGY ; *INTERBASIN WATER TRANSFER ; *RECREATION, OUTDOOR-WATER ; *WATER QUALITY STANDARDS ; *MULTIPLE USE-WATER ; MONITORING, ENV-WATER ; DISSOLVED OXYGEN
REVIEW CLASSIFICATION: 16

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GA253002396 0334579
Model for the late Cenozoic tectonic history of the Mojave Desert, California, and for its relation to adjacent regions
GARFUNKEL, Z
Bull Geol Soc Am (Boulder) 85/12 P1931-1944 1974 JRNL CODE: BGSAM
LANGUAGE: ENGLISH
DESCRIPTORS: TECTONICS
AUXILIARY DESCRIPTORS: CALIFORNIA; NEOGENE
DESCRIPTOR CODES: 710000
AUXILIARY DESCRIPTOR CODES: 796300; 085000

GA249003153 0330981
Model for the late Cenozoic tectonic history of the Mojave Desert, California, and for its relation to adjacent regions
GARFUNKEL, Z
Bull Geol Soc Am (Boulder) 85/12 P1931-1944 1974 JRNL CODE: BGSAM
LANGUAGE: ENGLISH
DESCRIPTORS: TECTONICS
AUXILIARY DESCRIPTORS: CALIFORNIA; NEOGENE
DESCRIPTOR CODES: 710000
AUXILIARY DESCRIPTOR CODES: 796300; 085000

GA241001833 0322555
Landscape inheritence and the pediment problem in the Mojave Desert of southern California
OBERLANDER, TM
Am J Sci (New Haven) 274/8 P849-875 1974 JRNL CODE: AJSCI
LANGUAGE: ENGLISH
DESCRIPTORS: EROSION CYCLES; DESERTS
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 740700; 742400
AUXILIARY DESCRIPTOR CODES: 796300; 004200

GA229000984 0308270
Fire opals in the Mojave Desert
NOWAK, G
Lapidary J (San Diego) 28/1 P52-56 1974 JRNL CODE: LJOUR
LANGUAGE: ENGLISH
DESCRIPTORS: OPAL (GEM)
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 483700
AUXILIARY DESCRIPTOR CODES: 796300

GA220002879 0304556
Early Miocene mammalian faunas, Mojave Desert, California
WOODBURNE, MO; TEDFORD, RH; STEVENS, MS; TAYLOR, BE
J Paleontol (Chicago) 48/1 P6-26 1974 JRNL CODE: JPALE
LANGUAGE: ENGLISH
DESCRIPTORS: MAMMALIA
AUXILIARY DESCRIPTORS: CALIFORNIA; LOWER MIOCENE
DESCRIPTOR CODES: 595000
AUXILIARY DESCRIPTOR CODES: 796300; 086300

GA269005949 0355221
Possible large lateral displacement by the San Andreas fault of Middle Tertiary marine units of the western Mojave Desert, California
DIBBLEE, TW
CONF. DATES: 25 MARCH TO 27 MARCH NO: 75-0066
Abstr Prog (Boulder) 7/3 P310-311 1975 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTING; FAULTS
AUXILIARY DESCRIPTORS: LOWER CALIFORNIAN PROVINCE; TERTIARY
DESCRIPTOR CODES: 731600; 737000
AUXILIARY DESCRIPTOR CODES: 769000; 081000

GA265002118 0347172
Evidence for continuing pediment evolution in the central Mojave Desert, California
WARNKE, DA
CONF. DATES: 18 NOVEMBER TO 20 NOVEM NO: 74-0262
Abstr Program (Boulder) 6/7 P1000-1001 1974 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: EROSION CYCLES; PALEOGEOMORPHOLOGY
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 740700; 771500
AUXILIARY DESCRIPTOR CODES: 796300

GA265001919 0346973
Continuing crustal deformation in the western Mojave Desert
CHURCH, JP; CASTLE, RO; CLARK, MM; MORTON, DM
CONF. DATES: 18 NOVEMBER TO 20 NOVEM NO: 74-0262
Abstr Program (Boulder) 6/7 P687-688 1974 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: DEFORMATION; FAULTING
AUXILIARY DESCRIPTORS: CALIFORNIA; HOLOCENE
DESCRIPTOR CODES: 731100; 731600
AUXILIARY DESCRIPTOR CODES: 796300; 099000

GA265001902 0346956
Early and late Mesozoic deformations in the Old Dad Mountain-CowholeMountains area, eastern Mojave Desert, California
DUNNE, GC; NOVITSKY, J; BURCHFIEL, BC
Geol Soc Am Cordilleran Sect Annu Meet (Las Vegas) CONF. DATES: 29 MARCH TO 31 MARCH NO: 74-0142
LANGUAGE: ENGLISH
DESCRIPTORS: DEFORMATION
AUXILIARY DESCRIPTORS: CALIFORNIA; MESOZOIC
DESCRIPTOR CODES: 731100
AUXILIARY DESCRIPTOR CODES: 796300; 055000

GA265001715 0346773
Experimental studies of granitoid rocks near the San Andreas fault zone in the Coast and Transverse Ranges and Mojave Desert, California
PIWINSKII, AJ
Tectonophysics (Amsterdam) 25/3-4 P217-231 1975 JRNL CODE: TECTO
LANGUAGE: ENGLISH
DESCRIPTORS: TRANSFORM FAULTS; EXPERIMENTAL PETROLOGY; GRANITES & ADAMELLITES
AUXILIARY DESCRIPTORS: PACIFIC COAST MOUNTAIN AREA; CALIFORNIA
DESCRIPTOR CODES: 726100; 540100; 543100
AUXILIARY DESCRIPTOR CODES: 727500; 796300

GA261003041 0343998
Potassium-argon ages of Tertiary volcanic rocks from the eastern Mojave Desert (California)
KUNIYOSHI, S; FREEMAN, T
Geol Soc Am Cordilleran Sect Annu Meet (Las Vegas) CONF. DATES: 29 MARCH TO 31 MARCH NO: 74-0142
LANGUAGE: ENGLISH
DESCRIPTORS: VOLCANIC ROCKS; POTASSIUM-ARGON DATING
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 546000; 756300
AUXILIARY DESCRIPTOR CODES: 796300

GA261001725 0342682
Groundwater investigation using uranium isotopes in the Mojave Desertregion
KNAUSS, KG; NARY, QL; KU, TL; STONE, RO
CONF. DATES: 18 NOVEMBER TO 20 NOVEM NO: 74-0262
Abstr Program (Boulder) 6/7 P827-828 1974 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: WATER TRACING TECHNIQUES; ISOTOPE GEOCHEMISTRY
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 490500; 670000
AUXILIARY DESCRIPTOR CODES: 796300; 004200

GA324003734 0412091
Origin of Mojave Desert dust plumes photographed from space
NAKATA, JK; WILSHIRE, HG; BARNES, GG
Geology (Boulder) 4/11 P644-648 1976 JRNL CODE: GEOLVI
LANGUAGE: ENGLISH
DESCRIPTORS: NATURAL POLLUTION; EOLIAN EROSION; PHOTOGRAMMETRIC SURVEYS
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 357100; 742100; 270100
AUXILIARY DESCRIPTOR CODES: 796300; 004200

GA316003952 0402681
SURFACE FAULTING ASSOCIATED WITH THE 5.2 MAGNITUDE GALWAY LAKE EARTHQUAKE OF MAY 31, 1975 - MOJAVE DESERT, SAN BERNARDINO COUNTY, CALIFORNIA
HILL, RL; BEEBY, DJ
Abstr Programs (Boulder) 8/3 P381 1976 JRNL CODE: APROGI
LANGUAGE: ENGLISH
DESCRIPTORS: EARTHQUAKES; FAULTING
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 682000; 731600
AUXILIARY DESCRIPTOR CODES: 796300

GA302000360 0382691
Geophysical investigations in the eastern Mojave Desert, California
ROTSTEIN, Y; COMBS, J; BIEHLER, S
CONF. DATES: 08 APRIL TO 12 APRIL NO: 74-0245
EOS Trans Am Geophys Union (Washington) 55/4 P448 1974 JRNL CODE: ETAGUI
LANGUAGE: ENGLISH
DESCRIPTORS: EXPLORATION GEOPHYSICS; STRESS & STRAIN; TECTONICS
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 334000; 730200; 710000
AUXILIARY DESCRIPTOR CODES: 796300

GA295004896 0376589
A swarm of earthquakes near the Pisgah fault in the Mojave Desert, California
FUIS, G
CONF. DATES: 12 DECEMBER TO 17 DECEM NO: 74-0412
EOS Trans Am Geophys Union 56/12 P1149 1974 JRNL CODE: ETAGU
LANGUAGE: ENGLISH
DESCRIPTORS: EARTHQUAKES; FAULTING
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 682000; 731600
AUXILIARY DESCRIPTOR CODES: 796300

GA295002185 0373983
Enhancement of geologic features near Mojave, California by spectralband ratioing of ERTS MSS data
MERIFIELD, PM; LAMAR, DL; LAMAR, JV
10 Annu Int Symp Remote Sensing Environ (Ann Arbor) CONF. DATES: 06 OCTOBER TO 16 OCTOB NO: 75-0133
LANGUAGE: ENGLISH
DESCRIPTORS: GEOSENSING; STRUCTURAL GEOLOGY
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 325500; 730000
AUXILIARY DESCRIPTOR CODES: 796300

GA287003882 0364407
Old contamination threatens regional water supply (Mojave River, California)
Ground Water Newsl (Port Washington) 4/13 P5 1975 JRNL CODE: GWNEW
LANGUAGE: ENGLISH
DESCRIPTORS: GROUNDWATER; HYDROGEOCHEMISTRY; ENVIRONMENTAL GEOLOGY
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 493000; 495000; 357000
AUXILIARY DESCRIPTOR CODES: 796300

GA269005956 0355228
Strike-slip displacement along the Camp Rock-Emerson fault, central Mojave Desert, San Bernardino County, California
HAWKINS, HG
CONF. DATES: 25 MARCH TO 27 MARCH NO: 75-0066
Abstr Prog (Boulder) 7/3 P324 1975 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTS
AUXILIARY DESCRIPTORS: CALIFORNIA; TERTIARY; QUATERNARY
DESCRIPTOR CODES: 737000
AUXILIARY DESCRIPTOR CODES: 796300; 081000; 080000

GA269005954 0355226
Southern Turtle Mountains a possible area of early basin and range structure in the southeastern Mojave desert
HATHEWAY, AW; KUNIYOSHI, S
CONF. DATES: 25 MARCH TO 27 MARCH NO: 75-0066
Abstr Prog (Boulder) 7/3 P322-323 1975 JRNL CODE: APROG
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTS
AUXILIARY DESCRIPTORS: CALIFORNIA; CENOZOIC
DESCRIPTOR CODES: 737000
AUXILIARY DESCRIPTOR CODES: 796300; 080000

GA354000737 0437887
Petrology of late Precambrian quartzose sandstones in the eastern Mojave Desert, southeastern California
LOBO, CF; OSBORNE, RH
J Sediment Petrol (Tulsa) 46/4 P829-846 1976 JRNL CODE: JSPSEI
LANGUAGE: ENGLISH
DESCRIPTORS: SANDSTONES & QUARTZITES; SEDIMENT PROVENANCE; SEDIMENTARY ENVIRONMENTS; MINERALOGICAL COMPOSITION OF SEDIMENTS; TIME SERIES ANALYSIS
AUXILIARY DESCRIPTORS: CALIFORNIA; PROTEROZOIC; CAMBRIAN
DESCRIPTOR CODES: 553300; 557100; 550500; 552100; 695100
AUXILIARY DESCRIPTOR CODES: 796300; 016000; 021000

GA354000438 0437610
Ultrapotassic, silica-rich, Tertiary volcanic rocks from the Mojave Desert, California
GLAZNER, AF; STORK, AL
CONF. DATES: 08 NOVEMBER TO 11 NOVEM NO: 76-0181
Abstr Programs (Boulder) 8/6 P886 1976 JRNL CODE: APROGI
LANGUAGE: ENGLISH
DESCRIPTORS: BASALTS; ANDESITES & RHYOLITES; PYROCLASTICS; IGNEOUS GEOCHEMISTRY
AUXILIARY DESCRIPTORS: CALIFORNIA; TERTIARY
DESCRIPTOR CODES: 546100; 546800; 546900; 666000
AUXILIARY DESCRIPTOR CODES: 796300; 081000

GA344000942 0429684
Variation of P-wave velocity before and after the Galway Lake earthquake (MI" 5.2) and the Goat Mountaan earthquakes (MI"4.7, 4.7), 1975,in the Mojave desert, California
KANAMORI, H; FUIS, G
Bull Seismol Soc Am (Berkeley) 66/6 P2017-2038 1976 JRNL CODE: BSSAMI
LANGUAGE: ENGLISH
DESCRIPTORS: EARTHQUAKE L, S & P WAVES; EARTHQUAKES
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS
DESCRIPTOR CODES: 682600; 682000
AUXILIARY DESCRIPTOR CODES: 796300; 004200

GA336002096 0422192
Gravity investigation in the southeastern Mojave Desert, California
ROTSTEIN, Y; COMBS, J; BIEHLER, S
Bull Geol Soc Am (Boulder) 87/7 P981-993 1976 JRNL CODE: BGSAMI
LANGUAGE: ENGLISH
DESCRIPTORS: GRAVIMETRIC PROSPECTING; GRAVITY ANOMALIES; SEDIMENTARY BASINS
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 334400; 685300; 557300
AUXILIARY DESCRIPTOR CODES: 796300

GA336001005 0421123
Enhancement of geologic features near Mojave, California by spectralband ratioing of ERTS MSS data
MERIFIELD, PM; LAMAR, DL; LAMAR, JV
10th Int Symp Remote Sensing Environ (Ann Arbor) CONF. DATES: 06 OCTOBER TO 10 OCTOB NO: 75-0133
P152-153 1975
LANGUAGE: ENGLISH
DESCRIPTORS: MULTISPECTRAL SURVEYS; REGIONAL GEOLOGY; GEOSENSING
AUXILIARY DESCRIPTORS: CALIFORNIA; PALEOZOIC
DESCRIPTOR CODES: 270800; 200000; 325500
AUXILIARY DESCRIPTOR CODES: 796300; 020100

GA336001004 0421122
Enhancement of geologic features near Mojave, California by spectralband ratioing of ERTS MSS data
MERIFIELD, PM; LAMAR, DL; LAMAR, JV
10th Int Symp Remote Sensing Environ (Ann Arbor) CONF. DATES: 06 OCTOBER TO 10 OCTOB NO: 75-0133
P152-153 1975
LANGUAGE: ENGLISH
DESCRIPTORS: MULTISPECTRAL SURVEYS; REGIONAL GEOLOGY; GEOSENSING
AUXILIARY DESCRIPTORS: CALIFORNIA; PALEOZOIC
DESCRIPTOR CODES: 270800; 200000; 325500
AUXILIARY DESCRIPTOR CODES: 796300; 020100

GA330003740 0417975
Theory of plasticity applied to faulting, Mojave Desert, southern California
CUMMINGS, D
Bull Geol Soc Am (Boulder) 87/5 P720-724 1976 JRNL CODE: BGSAMI
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTING; DEFORMATION
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 731600; 731100
AUXILIARY DESCRIPTOR CODES: 796300

GA391001566 0478506
Erosion off the road (Mojave desert)
WILSHIRE, HG; NAKATA, JK
Geotimes (Washington DC) 22/7-8 P27 1977 JRNL CODE: GEOTIG
LANGUAGE: ENGLISH
DESCRIPTORS: EOLIAN EROSION; SOIL EROSION; DESERTS
AUXILIARY DESCRIPTORS: CALIFORNIA; PLIOCENE; PLEISTOCENE
DESCRIPTOR CODES: 742100; 741900; 742400
AUXILIARY DESCRIPTOR CODES: 796300; 088000; 091000

GA387001054 0472652
Recent displacement and deformation along part of the San Andreas fault bordering Antelope Valley, western Mojave Desert
RUST, DJ
CONF. DATES: 05 APRIL TO 07 APRIL NO: 77-0107
Abstr Programs (Boulder) 9/4 P491-492 1977 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTS; DEFORMATION; EARTHQUAKE HISTORY
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 737000; 731100; 682100
AUXILIARY DESCRIPTOR CODES: 796300

GA387001019 0472618
Gravity-sliding in the Newberry Mountains, California, and its relationship to the late Cenozoic evolution of the Mojave structural block
DOKKA, RK
CONF. DATES: 05 APRIL TO 07 APRIL NO: 77-0107
Abstr Programs (Boulder) 9/4 P412 1977 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: GRAVITY GLIDING; OCEANIC PLATE SUBDUCTION; FAULTING
AUXILIARY DESCRIPTORS: CALIFORNIA; CENOZOIC
DESCRIPTOR CODES: 731500; 725000; 731600
AUXILIARY DESCRIPTOR CODES: 796300; 080000

GA387000824 0472429
Monocotyledoneous plants from the Lower Pliocene Ricardo Flora near Mojave, California
TIDWELL, WD; NAMBUDIRI, EMV; KEHRBERG, KD
CONF. DATES: 05 APRIL TO 07 APRIL NO: 77-0107
Abstr Programs (Boulder) 9/4 P516 1977 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: GYMNOSPERMAE
AUXILIARY DESCRIPTORS: CALIFORNIA; LOWER PLIOCENE
DESCRIPTOR CODES: 597700
AUXILIARY DESCRIPTOR CODES: 796300; 088500

GA376001140 0458477
Geology and structural evolution of Old Dad Mountain, Mojave Desert,California
DUNNE, GC
Bull Geol Soc Am (Boulder) 88/6 P737-748 1977 JRNL CODE: BGSAMI
LANGUAGE: ENGLISH
DESCRIPTORS: HISTORICAL GEOLOGY; PETROFABRICS; STRUCTURAL LINEAMENTS; HISTORICAL GEOLOGY; THRUSTS
AUXILIARY DESCRIPTORS: CALIFORNIA; PALEOZOIC; MESOZOIC; NEOGENE
DESCRIPTOR CODES: 750000; 730700; 730800; 750000; 738000
AUXILIARY DESCRIPTOR CODES: 796300; 020100; 055000; 085000

GA366002667 0449428
Off-road vehicle effects on California's mojave desert
WILSHIRE, HG; NAKATA, JK
Calif Geol (Sacramento) 29/6 P123-132 1976 JRNL CODE: CGEOSI
LANGUAGE: ENGLISH
DESCRIPTORS: SOIL EROSION; EOLIAN EROSION; BEDDING PLANE IRREGULARITIES & MARKINGS
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 741900; 742100; 556400
AUXILIARY DESCRIPTOR CODES: 796300

GA366001661 0448423
Late Precambrian-early Cambrian stratigraphy of the Kelso Mountains,eastern Mojave Desert, California
DUNNE, GC
69 Annu Meet Cordilleran Sect GSA (Portland) CONF. DATES: 22 MARCH TO 24 MARCH NO: 73-1117
LANGUAGE: ENGLISH
DESCRIPTORS: STRATIGRAPHY
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS; PROTEROZOIC; LOWER CAMBRIAN
DESCRIPTOR CODES: 760000
AUXILIARY DESCRIPTOR CODES: 796300; 004200; 016000; 021500

GA424000941 0500391
Preliminary stress measurements in the western Mojave Desert near Pal mdale
ZOBACK, MD
CONF. DATES: 17 APRIL TO 21 APRIL 1978 NO: 78-0036
EOS Trans Am Geophys Union (Washington DC) 59/4 P328 1978 JRNL CODE: ETAGUI
LANGUAGE: ENGLISH
DESCRIPTORS: STRESS & STRAIN; FAULTS
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 730200; 737000
AUXILIARY DESCRIPTOR CODES: 796300

GA423000963 0499266
Tectonic geomorphology of the central Mojave Desert of California
MENGES, CM; BULL, WB
CONF. DATES: 29 MARCH TO 31 MARCH 1978 NO: 78-0021
Abstr Programs (Boulder) 10/3 P137 1978 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: ARID & SEMIARID LANDFORMS; TECTONICS; FAULTING; REJUVENATION; PIEDMONT ENVIRONMENTS
AUXILIARY DESCRIPTORS: CALIFORNIA; DESERT REGIONS; QUATERNARY
DESCRIPTOR CODES: 742300; 710000; 731600; 740800; 551600
AUXILIARY DESCRIPTOR CODES: 796300; 004200; 090000

GA423000938 0499241
Active structures in the western Mojave Desert, California
BURKE, DB; HEDEL, CW
CONF. DATES: 29 MARCH TO 31 MARCH 1978 NO: 78-0021
Abstr Programs (Boulder) 10/3 P98 1978 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTS; FAULTING; TECTONIC CONTROL OF SEDIMENTATION; PLAYAS; EARTHQUAKE DISTRIBUTION
AUXILIARY DESCRIPTORS: CALIFORNIA; QUATERNARY
DESCRIPTOR CODES: 737000; 731600; 729900; 742900; 682200
AUXILIARY DESCRIPTOR CODES: 796300; 090000

GA423000910 0499214
Gravity tectonics and stratigraphic relations in the transition zone, Yuma and Mojave Counties, Arizona
GASSAWAY, JS
CONF. DATES: 29 MARCH TO 31 MARCH 1978 NO: 78-0021
Abstr Programs (Boulder) 10/3 P106 1978 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: GRAVITY GLIDING; STRATIGRAPHY
AUXILIARY DESCRIPTORS: ARIZONA; CENOZOIC
DESCRIPTOR CODES: 731500; 760000
AUXILIARY DESCRIPTOR CODES: 795300; 080000

GA423000657 0498965
Newly identified Proterozoic sedimentary facies at Seventeen Mile Poi nt, eastern Mojave Desert, California
OSBORNE, RH; WILSON, JT; MARIAN, MM; KNAUP, WH
CONF. DATES: 29 MARCH TO 31 MARCH 1978 NO: 78-0021
Abstr Programs (Boulder) 10/3 P140 1978 JRNL CODE: APROGG
LANGUAGE: ENGLISH
DESCRIPTORS: SEDIMENTARY ROCKS; LITHOSTRATIGRAPHY; SEDIMENT DISPERSAL
AUXILIARY DESCRIPTORS: CALIFORNIA; PROTEROZOIC
DESCRIPTOR CODES: 552000; 763000; 557200
AUXILIARY DESCRIPTOR CODES: 796300; 016000

GA396001203 0486186
Surface faulting associated with the 5.2 magnitude Galway Lake earthquake of May 31, 1975 Mojave Desert, San Bernardino County, California
HILL, RL; BEEBY, DJ
Bull Geol Soc Am (Boulder) 88/10 P1378-1384 1977 JRNL CODE: BGSAMI
LANGUAGE: ENGLISH
DESCRIPTORS: FAULTS; EARTHQUAKES; STRUCTURAL LINEAMENTS; FAULTING
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 737000; 682000; 730800; 731600
AUXILIARY DESCRIPTOR CODES: 796300

GA392001186 0479890
Hydrologic analysis of the Mojave River, California using a mathematical model
DURBIN, TJ; HARDT, WF
Gov Rep Announce (NTIS, Springfield Va 22161) PB-241-857P 1975 JRNL CODE: *GRAN
LANGUAGE: ENGLISH
DESCRIPTORS: RIVERS; NUMERICAL HYDROLOGY
AUXILIARY DESCRIPTORS: CALIFORNIA; RIVERS
DESCRIPTOR CODES: 491100; 490700
AUXILIARY DESCRIPTOR CODES: 796300; 005000

User2482 Date:20dec78 Time:11:21:11 File: 58

Set Items Description
1 41 MOJAVE

Print 1/5/1-41

Search Time: 0.019 Prints: 41 Descs.: 1

Print 1/5/1-2
DIALOG File20: FEDERAL INDEX 76-78/AUG SEE ALSO FILE 21(CURRENT WEEK) (Item 1 of 2) User2482 31oct78 2597

204085 cr e 78/07/14 P3768
Pattison NY: inserts letter to DOI-BLM favoring California Desert Conservation Area as wilderness
California House of Representatives-Members Bureau of Land Management Wilderness Areas insertions land use. purchase

126826 fr 76/11/23 P51662 PL94-579
DOI-BLM: establishes California Desert Conservation Area Advisory Committee. invites nominations
California Bureau of Land Management Land Use NEC notifications nec new organization

User2482 Date:31oct78 Time:14:39:11 File: 20

Set Items Description
1 2 CALIFORNIA(W)DESERT(W)CONSERVATI

Print 1/5/1-2

Search Time: 0.043 Prints: 2 Descs.: 4

76-03384
Ground-water quality in Indian Wells Valley, California.
WARNER, J.W.
USGS, Water Resources Div., 345 Middlefield Rd., Menlo Park, CA 94025
U.S. Geological Survey, Water-Resources Investigations 8-75, June 1975. 70pp. Publ.Yr: 75
Languages: E
Descriptors: INDIAN WELLS VALLEY; MOJAVE DESERT; CALIFORNIA; GROUNDWATER; HYDROLOGY; RESOURCE MANAGEMENT; WATER QUALITY MEASUREMENTS; WATER RESOURCES

76-01052
Sulfur dioxide data.
ANONYMOUS
California Air Quality Data, 7(1): 7-10, Jan.-Feb.-Mar. 1975. Publ.Yr: 75
Descriptors: CALIFORNIA AIR RESOURCES BOARD; SAN DIEGO; SAN FRANCISCO BAY AREA; SOUTH COAST AREA; SOUTHEAST DESERT AREA; AIR POLLUTION MEASUREMENTS; AIR QUALITY STANDARDS; CALIFORNIA; STATE AGENCIES; SULFUR DIOXIDE

75-03138
Characterization of California aerosols--II. Aerosol size distribution measurements in the Mojave Desert.
CLARK, W.E.; SVERDRUP, G.M.; WHITBY, K.T.
Univ. of Minnesota, Dept. of Mechanical Engineering; Particle Technology Lab., Minneapolis, MN 55455
Atmospheric Environment, 9(5): 483-494, May 1975. Publ.Yr: 75
Descriptors: MOJAVE DESERT; AEROSOLS; AIR POLLUTION MEASUREMENTS; CALIFORNIA; CHEMICAL ANALYSIS; PARTICLE SIZES

75-02417
Der Wasser- und Salzhaushalt des Salton Sea in Kalifornien.
SPAETH, H.-J.
Geographisches Seminar Gesamthochschule Duisburg, 41: Duisburg, Lotharstrasse 65, FRG
Wasserwirtschaft, 64(4):106-108 Apr. 1974. Publ.Yr: 74
Languages: G
Descriptors: COLORADO DESERT; SALTON SEA; CALIFORNIA; IRRIGATION; RECREATION AREAS; SALINITY; WATER MANAGEMENT

72-10112
Feedlot manure management in a desert climate.
California, Dept. of Agricultural Engineering, Davis USMARC, Livestock Environment Investigations, Clay Center, NB
Descriptors: ANIMAL WASTES; DESERT CLIMATE; CATTLE FEEDLOTS; CALIFORNIA; WASTE TREATMENT

71-00201
Arsenic in potable desert groundwater: An analysis problem.
WHITNACK, G. C.; MARTENS, H. H.
U. S. Naval Weapons Center, Michelson Lab., China Lake, CA
Science, 171(3969): 383-385, Jan. 29, 1971. Publ.Yr: 71
Descriptors: CALIFORNIA; ARSENIC; GROUND WATER; POTABLE WATER; SILVER DIETHYLDITHIOCARBAMATE METHOD; MOJAVE DESERT; MONITORING SYSTEMS

User2482 Date:31oct78 Time:14:36:39 File: 41

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Set Items Description
  1     0 CALIFORNIA(W)DESERT(W)CONSERVATI
  2     0 CALIFORNIA(W)DESERT
  3  1355 CALIFORNIA
  4    25 DESERT
  5     6 3AND4

Print 5/5/1-6

Search Time:  0.059   Prints:   6   Descs.:   6
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Print 1/5/2
DIALOG File58: GEOARCHIVE 74-78/SEP (Copr. GEOSYSTEMS) (Item 1 of 1) User2482 31oct78

GA366002161 0448922
Natural area in the California desert
Calif Geol (Sacramento) 29/5 P117-118 1976 JRNL CODE:
CGEOSI
LANGUAGE: ENGLISH
DESCRIPTORS: GEOLOGICAL CONSERVATION
AUXILIARY DESCRIPTORS: CALIFORNIA
DESCRIPTOR CODES: 355200
AUXILIARY DESCRIPTOR CODES: 796300

User2482 Date:31oct78 Time:14:27:03 File: 58

Set	Items	Description
1	4	CALIFORNIA(W)DESERT
2	7	CONSERVATION(W)AREA
3	0	1AND2
4	3137	CALIFORNIA
5	0	2AND4

Print 1/5/2

Search Time: 0.091 Prints: 1 Descs.: 5

Print 1/2/1
DIALOG File 47: MAGAZINE INDEX 77-78/OCT (Copr. IAC) (Item 1 of 1) User2482 31oct78

1016507
Palm oases of the California desert.
Bloomquist. Dick
Desert v40 p24(4) Jan 1977
DESCRIPTORS: California-description and travel

User2482 Date:31oct78 Time:14:21:39 File: 47

Set Items Description
  1   1 CALIFORNIA(W)DESERT
  2   0 CONSERVATION(W)AREA

Print 1/2/1

Search Time: 0.032 Prints: 1 Descs.: 4

APPENDIX F

FEDERAL WATER POLLUTION CONTROL ACT

FEDERAL WATER POLLUTION CONTROL ACT

(33 U.S.C. 1251, *et seq.*, PL 92-500; Enacted by Congress October 18, 1972, Overriding the President's Veto of October 17, 1972, as amended by PL 93-207, December 28, 1973, and PL 93-243, January 2, 1974; PL 93-592, January 2, 1975; PL 94-238, March 23, 1976; PL 94-558, October 19, 1976)

[*Editor's note:* The Federal Water Pollution Control Act Amendments of 1972, PL 92-500, replaced the previous language of the Act entirely, including the Water Quality Act of 1965, the Clean Water Restoration Act of 1966, and the Water Quality Improvement Act of 1970, all of which had been amendments of the Federal Water Pollution Control Act first passed in 1956.]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Federal Water Pollution Control Act Amendments of 1972".

SEC. 2. The Federal Water Pollution Control Act is amended to read as follows:

"TITLE I—RESEARCH AND RELATED PROGRAMS

"DECLARATION OF GOALS AND POLICY

"SEC. 101. (a) The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act—

"(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

"(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

"(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

"(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;

"(5) it is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State; and

"(6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans.

"(b) It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this Act. It is further the policy of the Congress to support and aid research relating to the prevention, reduction, and elimination of pollution, and to provide Federal technical services and financial aid to State and interstate agencies and municipalities in connection with the prevention, reduction, and elimination of pollution.

"(c) It is further the policy of Congress that the President, acting through the Secretary of State and such national and international organizations as he determines appropriate, shall take such action as may be necessary to insure that to the fullest extent possible all foreign countries shall take meaningful action for the prevention, reduction, and elimination of pollution in their waters and in international waters and for the achievement of goals regarding the elimination of discharge of pollutants and the improvement of water quality to at least the same extent as the United States does under its laws.

"(d) Except as otherwise expressly provided in this Act, the Administrator of the Environmental Protection Agency (hereinafter in this Act called 'Administrator') shall administer this Act.

"(e) Public participation in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program established by the Administrator or any State under this Act shall be provided for, encouraged, and assisted by the Administrator and the States. The Administrator, in cooperation with the States, shall develop and publish regulations specifying minimum guidelines for public participation in such processes.

"(f) It is the national policy that to the maximum extent possible the procedures utilized for implementing this Act shall encourage the drastic minimization of paperwork and interagency decision procedures, and the best use of available manpower and funds, so as to prevent needless duplication and unnecessary delays at all levels of government.

"COMPREHENSIVE PROGRAMS FOR WATER POLLUTION CONTROL

"SEC. 102. (a) The Administrator shall, after careful investigation, and in cooperation with other Federal agencies, State water pollution control agencies, interstate agencies, and the municipalities and industries involved, prepare or develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters. In the development of such comprehensive programs due regard shall be given to the improvements which are necessary to conserve such waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and the withdrawal of such waters for public water supply, agricultural, industrial, and other purposes. For the purpose of this section, the Administrator is authorized to make joint investigations with any such agencies of the condition of any waters in any State or States, and of the discharges of any sewage, industrial wastes, or substance which may adversely affect such waters.

"(b) (1) In the survey or planning of any reservoir by the Corps of Engineers, Bureau of Reclamation, or other Federal agency, consideration shall be given to inclusion of storage for regulation of streamflow, except that any such storage and water releases shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source.

"(2) The need for and the value of storage for regulation of streamflow (other than for water quality) including but not limited to navigation, salt water intrusion, recreation, esthetics, and fish and wildlife, shall be determined by the Corps of Engineers, Bureau of Reclamation, or other Federal agencies.

"(3) The need for, the value of, and the impact of, storage for water quality control shall be determined by the Administrator, and his views on these matters shall be set forth in any report or presentation to Congress proposing authorization or construction of any reservoir including such storage.

"(4) The value of such storage shall be taken into account in determining the economic value of the entire project of which it is a part, and costs shall be allocated to the purpose of regulation of streamflow in a manner which will insure that all project purposes, share equitably in the benefits of multiple-purpose construction.

"(5) Costs of regulation of streamflow features incorporated in any Federal reservoir or other impoundment under the provisions of this Act shall be determined and the beneficiaries identified and if the benefits are widespread or national in scope, the costs of such features shall be nonreimbursable.

"(6) No license granted by the Federal Power Commission for a hydroelectric power project shall include storage for regulation of streamflow for the purpose of water quality control unless the Administrator shall recommend its inclusion and such reservoir storage capacity shall not exceed such proportion of the total storage required for the water quality control plan as the drainage area of such reservoir bears to the drainage area of the river basin or basins involved in such water quality control plan.

"(c) (1) The Administrator shall, at the request of the Governor of a State, or a majority of the Governors when more than one State is involved, make a grant to pay not to exceed 50 per centum of the administrative expenses of a planning agency for a period not to exceed three years, which period shall begin after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, if such agency provides for adequate representation of appropriate State, interstate, local, or (when appropriate) international interests in the basin or portion thereof involved and is capable of developing an effective, comprehensive water quality control plan for a basin or portion thereof.

"(2) Each planning agency receiving a grant under this subsection shall develop a comprehensive pollution control plan for the basin or portion thereof which—

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"(A) is consistent with any applicable water quality standards, effluent and other limitations, and thermal discharge regulations established pursuant to current law within the basin;

"(B) recommends such treatment works as will provide the most effective and economical means of collection, storage, treatment, and elimination of pollutants and recommends means to encourage both municipal and industrial use of such works;

"(C) recommends maintenance and improvement of water quality within the basin or portion thereof and recommends methods of adequately financing those facilities as may be necessary to implement the plan; and

"(D) as appropriate, is developed in cooperation with, and is consistent with any comprehensive plan prepared by the Water Resources Council, any areawide waste management plans developed pursuant to section 208 of this Act, and any State plan developed pursuant to section 303(e) of this Act.

"(3) For the purposes of this subsection the term 'basin' includes, but is not limited to, rivers and their tributaries, streams, coastal waters, sounds, estuaries, bays, lakes, and portions thereof, as well as the lands drained thereby.

"INTERSTATE COOPERATION AND UNIFORM LAWS

"SEC. 103. (a) The Administrator shall encourage cooperative activities by the States for the prevention, reduction, and elimination of pollution, encourage the enactment of improved and, so far as practicable, uniform State laws relating to the prevention, reduction, and elimination of pollution; and encourage compacts between States for the prevention and control of pollution.

"(b) The consent of the Congress is hereby given to two or more States to negotiate and enter into agreements or compacts, not in conflict with any law or treaty of the United States, for (1) cooperative effort and mutual assistance for the prevention and control of pollution and the enforcement of their respective laws relating thereto, and (2) the establishment of such agencies, joint or otherwise, as they may deem desirable for making effective such agreements and compacts. No such agreement or compact shall be binding or obligatory upon any State a party thereto unless and until it has been approved by the Congress.

"RESEARCH, INVESTIGATIONS, TRAINING, AND INFORMATION

SEC. 104. (a) The Administrator shall establish national programs for the prevention, reduction, and elimination of pollution and as part of such programs shall—

"(1) in cooperation with other Federal, State, and local agencies, conduct and promote the coordination and acceleration of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of pollution;

"(2) encourage, cooperate with, and render technical services to pollution control agencies and other appropriate public or private agencies, institutions, and organizations, and individuals, including the general public, in the conduct of activities referred to in paragraph (1) of this subsection;

"(3) conduct, in cooperation with State water pollution control agencies and other interested agencies, organizations and persons, public investigations concerning the pollution of any navigable waters, and report on the results of such investigations;

"(4) establish advisory committees composed of recognized experts in various aspects of pollution and representatives of the public to assist in the examination and evaluation of research progress and proposals and to avoid duplication of research;

"(5) in cooperation with the States, and their political subdivisions, and other Federal agencies establish, equip, and maintain a water quality surveillance system for the purpose of monitoring the quality of the navigable waters and ground waters and the contiguous zone and the oceans and the Administrator shall, to the extent practicable, conduct such surveillance by utilizing the resources of the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the Geological Survey, and the Coast Guard, and shall report on such quality in the report required under subsection (a) of section 516; and

"(6) initiate and promote the coordination and acceleration of research designed to develop the most effective practicable tools and techniques for measuring the social and economic costs and benefits of activities which are subject to regulation under this Act; and shall transmit a report on the results of such research to the Congress not later than January 1, 1974.

(b) In carrying out the provisions of subsection (a) of this section the Administrator is authorized to—

"(1) collect and make available, through publications and other appropriate means, the results of and other information, including appropriate recommendations by him in connection therewith, pertaining to such research and other activities referred to in paragraph (1) of subsection (a);

"(2) cooperate with other Federal departments and agencies, State water pollution control agencies, interstate agencies, other public and private agencies, institutions, organizations, industries involved, and individuals, in the preparation and conduct of such research and other activities referred to in paragraph (1) of subsection (a);

"(3) make grants to State water pollution control agencies, interstate agencies, other public or nonprofit private agencies, institutions, organizations, and individuals, for purposes stated in paragraph (1) of subsection (a) of this section;

"(4) contract with public or private agencies, institutions, organizations, and individuals, without regard to sections 3648 and 3709 of the Revised Statutes (31 U.S.C. 529; 41 U.S.C. 5), referred to in paragraph (1) of subsection (a);

"(5) establish and maintain research fellowships at public or nonprofit private educational institutions or research organizations;

"(6) collect and disseminate, in cooperation with other Federal departments and agencies, and with other public or private agencies, institutions, and organizations having related responsibilities, basic data on chemical, physical, and biological effects of varying water quality and other information pertaining to pollution and the prevention, reduction, and elimination thereof; and

"(7) develop effective and practical processes, methods, and prototype devices for the prevention, reduction, and elimination of pollution.

"(c) In carrying out the provisions of subsection (a) of this section the Administrator shall conduct research on, and survey the results of other scientific studies on, the harmful effects on the health or welfare of persons caused by pollutants. In order to avoid duplication of effort, the Administrator shall, to the extent practicable, conduct such research in cooperation with and through the facilities of the Secretary of Health, Education, and Welfare.

"(d) In carrying out the provisions of this section the Administrator shall develop and demonstrate under varied conditions (including conducting such basic and applied research, studies, and experiments as may be necessary):

"(1) Practicable means of treating municipal sewage, and other waterborne wastes to implement the requirements of section 201 of this Act;

"(2) Improved methods and procedures to identify and measure the effects of pollutants, including those pollutants created by new technological developments; and

"(3) Methods and procedures for evaluating the effects on water quality of augmented streamflows to control pollution not susceptible to other means of prevention, reduction, or elimination.

"(e) The Administrator shall establish, equip, and maintain field laboratory and research facilities, including, but not limited to, one to be located in the northeastern area of the United States, one in the Middle Atlantic area, one in the southeastern area, one in the midwestern area, one in the southwestern area, one in the Pacific Northwest, and one in the State of Alaska, for the conduct of research, investigations, experiments, field demonstrations and studies, and training relating to the prevention, reduction and elimination of pollution. Insofar as practicable, each such facility shall be located near institutions of higher learning in which graduate training in such research might be carried out. In conjunction with the development of criteria under section 403 of this Act, the Administrator shall construct the facilities authorized for the National Marine Water Quality Laboratory established under this subsection.

"(f) The Administrator shall conduct research and technical development work, and make studies, with respect to the quality of the waters of the Great Lakes, including an analysis of the present and projected future water quality of the Great Lakes under varying conditions of waste treatment and disposal, an evaluation of the water quality needs of those to be served by such waters, an evaluation of municipal, industrial, and vessel waste treatment and disposal practices with respect to such waters, and a study of alternate means of solving pollution problems (including additional waste treatment measures) with respect to such waters.

"(g)(1) For the purpose of providing an adequate supply of trained personnel to operate and maintain existing and future treatment works and related activities, and for the purpose of enhancing substantially the proficiency of those engaged in such activities, the Administrator shall finance pilot programs, in cooperation with State and interstate agencies, municipalities, educational institutions, and other organizations and individuals, of manpower development and training and retraining of persons in, on entering into, the field of operation and maintenance of treatment works and related activities. Such program and any funds expended for such a program shall supplement, not supplant, other manpower and training programs and funds available for the purposes of this paragraph. The Administrator is authorized, under such terms and conditions as he deems appropriate, to enter into agreements with one or more States, acting jointly or sever-

ally, or with other public or private agencies or institutions for the development and implementation of such a program.

"(2) The Administrator is authorized to enter into agreements with public and private agencies and institutions, and individuals to develop and maintain an effective system for forecasting the supply of, and demand for, various professional and other occupational categories needed for the prevention, reduction, and elimination of pollution in each region, State, or area of the United States and, from time to time, to publish the results of such forecasts.

"(3) In furtherance of the purposes of this Act, the Administrator is authorized to—

"(A) make grants to public or private agencies and institutions and to individuals for training projects, and provide for the conduct of training by contract with public or private agencies and institutions and with individuals without regard to sections 3648 and 3709 of the Revised Statutes;

"(B) establish and maintain research fellowships in the Environmental Protection Agency with such stipends and allowances, including traveling and subsistence expenses, as he may deem necessary to procure the assistance of the most promising research fellows; and

"(C) provide, in addition to the program established under paragraph (1) of this subsection, training in technical matters relating to the causes, prevention, reduction, and elimination of pollution for personnel of public agencies and other persons with suitable qualifications.

"(4) The Administrator shall submit, through the President, a report to the Congress not later than December 31, 1973, summarizing the actions taken under this subsection and the effectiveness of such actions, and setting forth the number of persons trained, the occupational categories for which training was provided, the effectiveness of other Federal, State, and local training programs in this field, together with estimates of future needs, recommendations on improving training programs, and such other information and recommendations, including legislative recommendations, as he deems appropriate.

"(h) The Administrator is authorized to enter into contracts with, or make grants to, public or private agencies and organizations and individuals for (A) the purpose of developing and demonstrating new or improved methods for the prevention, removal, reduction, and elimination of pollution in lakes, including the undesirable effects of nutrients and vegetation, and (B) the construction of publicly owned research facilities for such purpose.

"(i) The Administrator, in cooperation with the Secretary of the department in which the Coast Guard is operating, shall—

"(1) engage in such research, studies, experiments, and demonstrations as he deems appropriate, relative to the removal of oil from any waters and to the prevention, control, and elimination of oil and hazardous substances pollution;

"(2) publish from time to time the results of such activities; and

"(3) from time to time, develop and publish in the Federal Register specifications and other technical information on the various chemical compounds used in the control of oil and hazardous substances spills.

In carrying out this subsection, the Administrator may enter into contracts with, or make grants to, public or private agencies and organizations and individuals.

"(j) The Secretary of the department in which the Coast Guard is operating shall engage in such research, studies, experiments, and demonstrations as he deems appropriate relative to equipment which is to be installed on board a vessel and is designed to receive, retain, treat, or discharge human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes with particular emphasis on equipment to be installed on small recreational vessels. The Secretary of the department in which the Coast Guard is operating shall report to Congress the results of such research, studies, experiments, and demonstrations prior to the effective date of any regulations established under section 312 of this Act. In carrying out this subsection the Secretary of the department in which the Coast Guard is operating may enter into contracts with, or make grants to, public or private organizations and individuals.

"(k) In carrying out the provisions of this section relating to the conduct by the Administrator of demonstration projects and the development of field laboratories and research facilities, the Administrator may acquire land and interests therein by purchase, with appropriated or donated funds, by donation, or by exchange for acquired or public lands under his jurisdiction which he classifies as suitable for disposition. The values of the properties so exchanged either shall be approximately equal, or if they are not approximately equal, the values shall be equalized by the payment of cash to the grantor or to the Administrator as the circumstances require.

"(l)(1) The Administrator shall, after consultation with appropriate local, State, and Federal agencies, public and private organizations, and interested individuals, as soon as practicable but not later than January 1, 1973, develop and issue to the States for the purpose of carrying out this Act the latest scientific knowledge available in indicating the kind and extent of effects on health and welfare which may be expected from the presence of pesticides in the water in varying quantities. He shall revise and add to such information whenever necessary to reflect developing scientific knowledge.

"(2) The President shall, in consultation with appropriate local, State, and Federal agencies, public and private organizations, and interested individuals, conduct studies and investigations of methods to control the release of pesticides into the environment which study shall include examination of the persistency of pesticides in the water environment and alternatives thereto. The President shall submit reports, from time to time, on such investigations to Congress together with his recommendations for any necessary legislation.

"(m)(1) The Administrator shall, in an effort to prevent degradation of the environment from the disposal of waste oil, conduct a study of (A) the generation of used engine, machine, cooling, and similar waste oil, including quantities generated, the nature and quality of such oil, present collecting methods and disposal practices, and alternate uses of such oil; (B) the long-term, chronic biological effects of the disposal of such waste oil; and (C) the potential market for such oils, including the economic and legal factors relating to the sale of products made from such oils, the level of subsidy, if any, needed to encourage the purchase by public and private nonprofit agencies of products from such oil, and the practicability of Federal procurement, on a priority basis, of products made from such oil. In conducting such study, the Administrator shall consult with affected industries and other persons.

"(2) The Administrator shall report the preliminary results of such study to Congress within six months after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, and shall submit a final report to Congress within 18 months after such date of enactment.

"(n)(1) The Administrator shall, in cooperation with the Secretary of the Army, the Secretary of Agriculture, the Water Resources Council, and with other appropriate Federal, State, interstate, or local public bodies and private organizations, institutions, and individuals, conduct and promote, and encourage contributions to, continuing comprehensive studies of the effects of pollution, including sedimentation, in the estuaries and estuarine zones of the United States on fish and wildlife, on sport and commercial fishing, on recreation, on water supply and water power, and on other beneficial purposes. Such studies shall also consider the effect of demographic trends, the exploitation of mineral resources and fossil fuels, land and industrial development, navigation, flood and erosion control, and other uses of estuaries and estuarine zones upon the pollution of the waters therein.

"(2) In conducting such studies, the Administrator shall assemble, coordinate, and organize all existing pertinent information on the Nation's estuaries and estuarine zones; carry out a program of investigations and surveys to supplement existing information in representative estuaries and estuarine zones; and identify the problems and areas where further research and study are required.

"(3) The Administrator shall submit to Congress, from time to time, reports of the studies authorized by this subsection but at least one such report during any three year period. Copies of each such report shall be made available to all interested parties, public and private.

"(4) For the purpose of this subsection, the term 'estuarine zones' means an environmental system consisting of an estuary and those transitional areas which are consistently influenced or affected by water from an estuary such as, but not limited to, salt marshes, coastal and intertidal areas, bays, harbors, lagoons, inshore waters, and channels, and the term 'estuary' means all or part of the mouth of a river or stream or other body of water having unimpaired natural connection with open sea and within which the sea water is measurably diluted with fresh water derived from land drainage.

"(o)(1) The Administrator shall conduct research and investigations on devices, systems, incentives, pricing policy, and other methods of reducing the total flow of sewage, including, but not limited to, unnecessary water consumption in order to reduce the requirements for, and the costs of, sewage and waste treatment services. Such research and investigations shall be directed to develop devices, systems, policies, and methods capable of achieving the maximum reduction of unnecessary water consumption.

"(2) The Administrator shall report the preliminary results of such studies and investigations to the Congress within one year after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, and annually thereafter in the report required under subsection (a) of section 516. Such report shall include recommendations for any legislation that may be required to provide for the adoption and use of devices, systems, policies, or other methods of reducing water consumption and reducing the total flow of sewage. Such report shall include an estimate of the benefits to be derived from adoption and use of such devices, systems, policies, or other methods and also shall reflect estimates of any increase in private, public, or other cost that would be occasioned thereby.

"(p) In carrying out the provisions of subsection (a) of this section the Administrator shall, in cooperation with the Secretary of Agriculture, other Federal agencies, and the States, carry out a compre-

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hensive study and research program to determine new and improved methods and the better application of existing methods of preventing, reducing, and eliminating pollution from agriculture, including the legal, economic, and other implications of the use of such methods.

"(q)(1) The Administrator shall conduct a comprehensive program of research and investigation and pilot project implementation into new and improved methods of preventing, reducing, storing, collecting, treating, or otherwise eliminating pollution from sewage in rural and other areas where collection of sewage in conventional, community-wide sewage collection systems is impractical, uneconomical, or otherwise infeasible, or where soil conditions or other factors preclude the use of septic tank and drainage field systems.

"(2) The Administrator shall conduct a comprehensive program of research and investigation and pilot project implementation into new and improved methods for the collection and treatment of sewage and other liquid wastes combined with the treatment and disposal of solid wastes.

"(r) The Administrator is authorized to make grants to colleges and universities to conduct basic research into the structure and function of fresh water aquatic ecosystems, and to improve understanding of the ecological characteristics necessary to the maintenance of the chemical, physical, and biological integrity of freshwater aquatic ecosystems.

"(s) The Administrator is authorized to make grants to one or more institutions of higher education (regionally located and to be designated as 'River Study Centers') for the purpose of conducting and reporting on interdisciplinary studies on the nature of river systems, including hydrology, biology, ecology, economics, the relationship between river uses and land uses, and the effects of development within river basins on river systems and on the value of water resources and water related activities. No such grant in any fiscal year shall exceed $1,000,000.

"(t) The Administrator shall, in cooperation with State and Federal agencies and public and private organizations, conduct continuing comprehensive studies of the effects and methods of control of thermal discharges. In evaluating alternative methods of control the studies shall consider (1) such data as are available on the latest available technology, economic feasibility including cost-effectiveness analysis, and (2) the total impact on the environment, considering not only water quality but also air quality, land use, and effective utilization and conservation of fresh water and other natural resources. Such studies shall consider methods of minimizing adverse effects and maximizing beneficial effects of thermal discharges. The results of these studies shall be reported by the Administrator upon as practicable, but not later than 270 days after enactment of this subsection, and shall be made available to the public and the States, and considered as they become available by the Administrator in carrying out section 316 of this Act and by the States in proposing thermal water quality standards.

"(u) There is authorized to be appropriated (1) $100,000,000 per fiscal year for the fiscal year ending June 30, 1973, the fiscal year ending June 30, 1974, and the fiscal year ending June 30, 1975, for carrying out the provisions of this section other than subsections (g)(1) and (2), (p), (r), and (t); (2) not to exceed $7,500,000 for fiscal years 1973, 1974, and 1975 for carrying out the provisions of subsection (g)(1); (3) not to exceed $2,500,000 for fiscal years 1973, 1974, and 1975 for carrying out the provisions of subsection (g)(2); (4) not to exceed $10,000,000 for each of the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, for carrying out the provisions of subsection (p); (5) not to exceed $15,000,000 per fiscal year for the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, for carrying out the provisions of subsection (r); and (6) not to exceed $10,000,000 per fiscal year for the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975 for carrying out the provisions of subsection (t).

"GRANTS FOR RESEARCH AND DEVELOPMENT

"SEC. 105. (a) The Administrator is authorized to conduct in the Environmental Protection Agency, and to make grants to any State, municipality, or intermunicipal or interstate agency for the purpose of assisting in the development of—

"(1) any project which will demonstrate a new or improved method of preventing, reducing, and eliminating the discharge into any waters of pollutants from sewers which carry storm water or both storm water and pollutants; or

"(2) any project which will demonstrate advanced waste treatment and water purification methods (including the temporary use of new or improved chemical additives which provide substantial immediate improvement to existing treatment processes), or new or improved methods of joint treatment systems for municipal and industrial wastes;

and to include in such grants such amounts as are necessary for the purpose of reports, plans, and specifications in connection therewith.

"(b) The Administrator is authorized to make grants to any State or States or interstate agency to demonstrate, in river basins or portions thereof, advanced treatment and environmental enhancement techniques to control pollution from all sources, within such basins or portions thereof, including nonpoint sources, together with in stream water quality improvement techniques.

"(c) In order to carry out the purposes of section 301 of this Act, the Administrator is authorized to (1) conduct in the Environmental Protection Agency, (2) make grants to persons, and (3) enter into contracts with persons, for research and demonstration projects for prevention of pollution of any waters by industry including, but not limited to, the prevention, reduction, and elimination of the discharge of pollutants. No grant shall be made for any project under this subsection unless the Administrator determines that such project will develop or demonstrate a new or improved method of treating industrial wastes or otherwise prevent pollution by industry, which method shall have industrywide application.

"(d) In carrying out the provisions of this section, the Administrator shall conduct, on a priority basis, an accelerated effort to develop, refine, and achieve practical application of:

"(1) waste management methods applicable to point and nonpoint sources of pollutants to eliminate the discharge of pollutants, including, but not limited to, elimination of runoff of pollutants and the effects of pollutants from inplace or accumulated sources;

"(2) advanced waste treatment methods applicable to point and nonpoint sources, including inplace or accumulated sources of pollutants, and methods for reclaiming and recycling water and confining pollutants so they will not migrate to cause water or other environmental pollution; and

"(3) improved methods and procedures to identify and measure the effects of pollutants on the chemical, physical, and biological integrity of water, including those pollutants created by new technological developments.

"(e)(1) The Administrator is authorized to (A) make, in consultation with the Secretary of Agriculture, grants to persons for research and demonstration projects with respect to new and improved methods of preventing, reducing, and eliminating pollution from agriculture, and (B) disseminate, in cooperation with the Secretary of Agriculture, such information obtained under this subsection, section 104(p), and section 304 as will encourage and enable the adoption of such methods in the agricultural industry.

"(2) The Administrator is authorized, (A) in consultation with other interested Federal agencies, to make grants for demonstration projects with respect to new and improved methods of preventing, reducing, storing, collecting, treating, or otherwise eliminating pollution from sewage in rural and other areas where collection of sewage in conventional, community-wide sewage collection systems is impractical, uneconomical, or otherwise infeasible, or where soil conditions or other factors preclude the use of septic tank and drainage field systems, and (B) in cooperation with other interested Federal and State agencies, to disseminate such information obtained under this subsection as will encourage and enable the adoption of new and improved methods developed pursuant to this subsection.

"(f) Federal grants under subsection (a) of this section shall be subject to the following limitations:

"(1) No grant shall be made for any project unless such project shall have been approved by the appropriate State water pollution control agency or agencies and by the Administrator;

"(2) No grant shall be made for any project in an amount exceeding 75 per centum of cost thereof as determined by the Administrator; and

"(3) No grant shall be made for any project unless the Administrator determines that such project will serve as a useful demonstration for the purpose set forth in clause (1) or (2) of subsection (a).

"(g) Federal grants under subsections (c) and (d) of this section shall not exceed 75 per centum of the cost of the project.

"(h) For the purpose of this section there is authorized to be appropriated $75,000,000 per fiscal year for the fiscal year ending June 30, 1973, the fiscal year ending June 30, 1974, and the fiscal year ending June 30, 1975, and from such appropriations at least 10 per centum of the funds actually appropriated in each fiscal year shall be available only for the purposes of subsection (e).

"GRANTS FOR POLLUTION CONTROL PROGRAMS

"SEC. 106. (a) There are hereby authorized to be appropriated the following sums, to remain available until expended, to carry out the purposes of this section—

"(1) $60,000,000 for the fiscal year ending June 30, 1973; and

"(2) $75,000,000 for the fiscal year ending June 30, 1974, and the fiscal year ending June 30, 1975; for grants to States and to interstate agencies to assist them in administering programs for the prevention, reduction, and elimination of pollution, including enforcement directly or through appropriate State law enforcement officers or agencies.

"(b) From the sums appropriated in any fiscal year, the Administrator shall make allotments to the several States and interstate agencies in accordance with regulations promulgated by him on the basis of the extent of the pollution problem in the respective States.

"(c) The Administrator is authorized to pay to each State and interstate agency each fiscal year either—

"(1) the allotment of such State or agency for such fiscal year under subsection (b), or

"(2) the reasonable costs as determined by the Administrator of developing and carrying out a pollution program by such State or agency during such fiscal year.

which ever amount is the lesser.

"(d) No grant shall be made under this section to any State or interstate agency for any fiscal year when the expenditure of non-Federal funds by such State or interstate agency during such fiscal year for the recurrent expenses of carrying out its pollution control program are less than the expenditure by such State or interstate agency of non-Federal funds for such recurrent program expenses during the fiscal year ending June 30, 1971.

"(e) Beginning in fiscal year 1974 the Administrator shall not make any grant under this section to any State which has not provided or is not carrying out as a part of its program—

"(1) the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to eutrophic condition), the quality of navigable waters and to the extent practicable, ground waters including biological monitoring; and provision for annually updating such data and including it in the report required under section 305 of this Act;

"(2) authority comparable to that in section 504 of this Act and adequate contingency plans to implement such authority.

"(f) Grants shall be made under this section on condition that—

"(1) Such State (or interstate agency) files with the Administrator within one hundred and twenty days after the date of enactment of this section:

"(A) a summary report of the current status of the State pollution control program, including the criteria used by the State in determining priority of treatment works; and

"(B) such additional information, data, and reports as the Administrator may require.

"(2) No federally assumed enforcement as defined in section 309 (a)(2) is in effect with respect to such State or interstate agency.

"(3) Such State (or interstate agency) submits within one hundred and twenty days after the date of enactment of this section and before July 1 of each year thereafter for the Administrator's approval its program for the prevention, reduction, and elimination of pollution in accordance with purposes and provisions of this Act in such form and content as the Administrator may prescribe.

"(g) Any sums allotted under subsection (b) in any fiscal year which are not paid shall be reallotted by the Administrator in accordance with regulations promulgated by him.

"MINE WATER POLLUTION CONTROL DEMONSTRATIONS

"SEC. 107. (a) The Administrator in cooperation with the Appalachian Regional Commission and other Federal agencies is authorized to conduct, to make grants for, or to contract for, projects to demonstrate comprehensive approaches to the elimination or control of acid or other mine water pollution resulting from active or abandoned mining operations and other environmental pollution affecting water quality within all or part of a watershed or river basin, including siltation from surface mining. Such projects shall demonstrate the engineering and economic feasibility and practicality of various abatement techniques which will contribute substantially to effective and practical methods of acid or other mine water pollution elimination or control, and other pollution affecting water quality, including techniques that demonstrate the engineering and economic feasibility and practicality of using sewage sludge materials and other municipal wastes to diminish or prevent pollution affecting water quality from acid, sedimentation, or other pollutants and in such projects to restore affected lands to usefulness for forestry, agriculture, recreation, or other beneficial purposes.

"(b) Prior to undertaking any demonstration project under this section in the Appalachian region (as defined in section 403 of the Appalachian Regional Development Act of 1965, as amended), the Appalachian Regional Commission shall determine that such demonstration project is consistent with the objectives of the Appalachian Regional Development Act of 1965, as amended.

"(c) The Administrator, in selecting watersheds for the purposes of this section, shall be satisfied that the project area will not be affected adversely by the influx of acid or other mine water pollution from nearby sources.

"(d) Federal participation in such projects shall be subject to the conditions—

"(1) that the State shall acquire any land or interests therein necessary for such project; and

"(2) that the State shall provide legal and practical protection to the project area to insure against any activities which will cause future acid or other mine water pollution.

"(e) There is authorized to be appropriated $30,000,000 to carry out the provisions of this section, which sum shall be available until expended.

"POLLUTION CONTROL IN GREAT LAKES

"SEC. 108. (a) The Administrator, in cooperation with other Federal departments, agencies, and instrumentalities is authorized to enter into agreements with any State, political subdivision, interstate agency, or other public agency, or combination thereof, to carry out one or more projects to demonstrate new methods and techniques and to develop preliminary plans for the elimination or control of pollution, within all or any part of the watersheds of the Great Lakes. Such projects shall demonstrate the engineering and economic feasibility and practicality of removal of pollutants and prevention of any polluting matter from entering into the Great Lakes in the future and other reduction and remedial techniques which will contribute substantially to effective and practical methods of pollution prevention, reduction, or elimination.

"(b) Federal participation in such projects shall be subject to the condition that the State, political subdivision, interstate agency, or other public agency, or combination thereof, shall pay not less than 25 per centum of the actual project costs, which payment may be in any form, including, but not limited to, land or interests therein that is needed for the project, and personal property or services the value of which shall be determined by the Administrator.

"(c) There is authorized to be appropriated $20,000,000 to carry out the provisions of subsections (a) and (b) of this section, which sum shall be available until expended.

"(d)(1) In recognition of the serious conditions which exist in Lake Erie, the Secretary of the Army, acting through the Chief of Engineers, is directed to design and develop a demonstration waste water management program for the rehabilitation and environmental repair of Lake Erie. Prior to the initiation of detailed engineering and design, the program, along with the specific recommendations of the Chief of Engineers, and recommendations for its financing, shall be submitted to the Congress for statutory approval. This authority is in addition to, and not in lieu of, other waste water studies aimed at eliminating pollution emanating from select sources around Lake Erie.

"(2) This program is to be developed in cooperation with the Environmental Protection Agency, other interested departments, agencies, and instrumentalities of the Federal Government, and the States and their political subdivisions. This program shall set forth alternative systems for managing waste water on a regional basis and shall provide local and State governments with a range of choice as to the type of system to be used for the treatment of waste water. These alternative systems shall include both advanced waste treatment technology and land disposal systems including aerated treatment-spray irrigation technology and will also include provisions for the disposal of solid wastes, including sludge. Such program should include measures to control point sources of pollution, area sources of pollution, including acid-mine drainage, urban runoff and rural runoff, and in place sources of pollution, including bottom loads, sludge banks, and polluted harbor dredgings.

"(e) There is authorized to be appropriated $5,000,000 to carry out the provisions of subsection (d) of this section, which sum shall be available until expended.

"TRAINING GRANTS AND CONTRACTS

"SEC. 109. (a) The Administrator is authorized to make grants to or contracts with institutions of higher education, or combinations of such institutions, to assist them in planning, developing, strengthening, improving, or carrying out programs or projects for the preparation of undergraduate students to enter an occupation which involves the design, operation, and maintenance of treatment works, and other facilities whose purpose is water quality control. Such grants or contracts may include payment of all or part of the cost of programs or projects such as—

"(A) planning for the development or expansion of programs or projects for training persons in the operation and maintenance of treatment works;

"(B) training and retraining of faculty members;

"(C) conduct of short-term or regular session institutes for study by persons engaged in, or preparing to engage in, the preparation of students preparing to enter an occupation involving the operation and maintenance of treatment works;

"(D) carrying out innovative and experimental programs of cooperative education involving alternate periods of full-time or part-time academic study at the institution and periods of full-time or part-time employment involving the operation and maintenance of treatment works; and

"(E) research into, and development of, methods of training students or faculty, including the preparation of teaching materials and the planning of curriculum.

"(b)(1) The Administrator may pay 100 per centum of any additional cost of construction of a treatment works required for a facility to train and upgrade waste treatment works operation and maintenance personnel.

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"(2) The Administrator shall make no more than one grant for such additional construction in any State (to serve a group of States, where, in his judgment, efficient training programs require multi-State programs), and shall make such grant after consultation with and approval by the State or States on the basis of (A) the suitability of such facility for training operation and maintenance personnel for treatment works throughout such State or States; and (B) a commitment by the State agency or agencies to carry out at such facility a program of training approved by the Administrator.

"(3) The Administrator may make such grant out of the sums allocated to a State under section 205 of this Act, except that in no event shall the Federal cost of any such training facilities exceed $250,000.

"APPLICATION FOR TRAINING GRANT OR CONTRACT; ALLOCATION OF GRANTS OR CONTRACTS

"SEC. 110. (1) A grant or contract authorized by section 109 may be made only upon application to the Administrator at such time or times and containing such information as he may prescribe, except that no such application shall be approved unless it—

"(A) sets forth programs, activities, research, or development for which a grant is authorized under section 109 and describes the relation to any program set forth by the applicant in an application, if any, submitted pursuant to section 111;

"(B) provides such fiscal control and fund accounting procedures as may be necessary to assure proper disbursement of and accounting for Federal funds paid to the applicant under this section; and

"(C) provides for making such reports, in such form and containing such information, as the Administrator may require to carry out his functions under this section, and for keeping such records and for affording such access thereto as the Administrator may find necessary to assure the correctness and verification of such reports.

"(2) The Administrator shall allocate grants or contracts under section 109 in such manner as will most nearly provide an equitable distribution of the grants or contracts throughout the United States among institutions of higher education which show promise of being able to use funds effectively for the purpose of this section.

"(3) (A) Payment under this section may be used in accordance with regulations of the Administrator, and subject to the terms and conditions set forth in an application approved under paragraph (1), to pay part of the compensation of students employed in connection with the operation and maintenance of treatment works, other than as an employee in connection with the operation and maintenance of treatment works or as an employee in any branch of the Government of the United States, as part of a program for which a grant has been approved pursuant to this section.

"(B) Departments and agencies of the United States are encouraged, to the extent consistent with efficient administration, to enter into arrangements with institutions of higher education for the full-time, part-time, or temporary employment, whether in the competitive or excepted service, of students enrolled in programs set forth in applications approved under paragraph (1).

"AWARD OF SCHOLARSHIPS

"SEC. 111. (1) The Administrator is authorized to award scholarships in accordance with the provisions of this section for undergraduate study by persons who plan to enter an occupation involving the operation and maintenance of treatment works. Such scholarships shall be awarded for such periods as the Administrator may determine but not to exceed four academic years.

"(2) The Administrator shall allocate scholarships under this section among institutions of higher education with programs approved under the provisions of this section for the use of individuals accepted into such programs, in such manner and according to such plan as will insofar as practicable—

"(A) provide an equitable distribution of such scholarships throughout the United States; and

"(B) attract recent graduates of secondary schools to enter an occupation involving the operation and maintenance of treatment works.

"(3) The Administrator shall approve a program of any institution of higher education for the purposes of this section only upon application by the institution and only upon his finding—

"(A) that such program has a principal objective the education and training of persons in the operation and maintenance of treatment works;

"(B) that such program is in effect and of high quality, or can be readily put into effect and may reasonably be expected to be of high quality;

"(C) that the application describes the relation of such program to any program, activity, research, or development set forth by the applicant in an application, if any, submitted pursuant to section 110 of this Act; and

"(D) that the application contains satisfactory assurances that (i) the institution will recommend to the Administrator for the award of scholarships under this section, for study in such program, only persons who have demonstrated to the satisfaction of the institution a serious intent, upon completing the program, to enter an occupation involving the operation and maintenance of treatment works, and (ii) the institution will make reasonable continuing efforts to encourage recipients of scholarships under this section, enrolled in such program, to enter occupations involving the operation and maintenance of treatment works upon completing the program.

"(4) (A) The Administrator shall pay to persons awarded scholarships under this section such stipends (including such allowances for subsistence and other expenses for such persons and their dependents) as he may determine to be consistent with prevailing practices under comparable federally supported programs.

"(B) The Administrator shall (in addition to the stipends paid to persons under paragraph (1)) pay to the institution of higher education at which such person is pursuing his course of study such amount as he may determine to be consistent with prevailing practices under comparable federally supported programs.

"(5) A person awarded a scholarship under the provisions of this section shall continue to receive the payments provided in this section only during such periods as the Administrator finds that he is maintaining satisfactory proficiency and devoting full time to study or research in the field in which such scholarship was awarded in an institution of higher education, and is not engaging in gainful employment other than employment approved by the Administrator by or pursuant to regulation.

"(6) The Administrator shall by regulation provide that any person awarded a scholarship under this section shall agree in writing to enter and remain in an occupation involving the design, operation, or maintenance of treatment works for such period after completion of his course of studies as the Administrator determines appropriate.

"DEFINITIONS AND AUTHORIZATIONS

"SEC. 112. (a) As used in sections 109 through 112 of this Act—

"(1) The term 'institution of higher education' means an educational institution described in the first sentence of section 1201 of the Higher Education Act of 1965 (other than an institution of any agency of the United States) which is accredited by a nationally recognized accrediting agency or association approved by the Administrator for this purpose. For purposes of this subsection, the Administrator shall publish a list of nationally recognized accrediting agencies or associations which he determines to be reliable authority as to the quality of training offered.

"(2) The term 'academic year' means an academic year or its equivalent, as determined by the Administrator.

"(b) The Administrator shall annually report his activities under sections 109 through 112 of this Act, including recommendations for needed revisions in the provisions thereof.

"(c) There are authorized to be appropriated $25,000,000 per fiscal year for the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, to carry out sections 109 through 112 of this Act.

"ALASKA VILLAGE DEMONSTRATION PROJECTS

"SEC. 113. (a) The Administrator is authorized to enter into agreements with the State of Alaska to carry out one or more projects to demonstrate methods to provide for central community facilities for safe water and elimination or control of pollution in those native villages of Alaska without such facilities. Such project shall include provisions for community safe water supply systems, toilets, bathing and laundry facilities, sewage disposal facilities, and other similar facilities, and educational and informational facilities and programs relating to health and hygiene. Such demonstration projects shall be for the further purpose of developing preliminary plans for providing such safe water and such elimination or control of pollution for all native villages in such State.

"(b) In carrying out this section the Administrator shall cooperate with the Secretary of Health, Education, and Welfare for the purpose of utilizing such of the personnel and facilities of that Department as may be appropriate.

S. 2770—18

"(c) The Administrator shall report to Congress not later than July 1, 1973, the results of the demonstration projects authorized by this section together with his recommendations, including any necessary legislation, relating to the establishment of a statewide program.

"(d) There is authorized to be appropriated not to exceed $2,000,000 to carry out this section.

"LAKE TAHOE STUDY

"SEC. 114. (a) The Administrator, in consultation with the Tahoe Regional Planning Agency, the Secretary of Agriculture, other Federal agencies, representatives of State and local governments, and

members of the public, shall conduct a thorough and complete study on the adequacy of and need for extending Federal oversight and control in order to preserve the fragile ecology of Lake Tahoe.

"(b) Such study shall include an examination of the interrelationships and responsibilities of the various agencies of the Federal Government and State and local governments with a view to establishing the necessity for redefinition of legal and other arrangements between these various governments, and making specific legislative recommendations to Congress. Such study shall consider the effect of various actions in terms of their environmental impact on the Tahoe Basin, treated as an ecosystem.

"(c) The Administrator shall report on such study to Congress not later than one year after the date of enactment of this subsection.

"(d) There is authorized to be appropriated to carry out this section not to exceed $500,000.

"IN-PLACE TOXIC POLLUTANTS

"SEC. 115. The Administrator is directed to identify the location of in-place pollutants with emphasis on toxic pollutants in harbors and navigable waterways and is authorized, acting through the Secretary of the Army, to make contracts for the removal and appropriate disposal of such materials from critical port and harbor areas. There is authorized to be appropriated $15,000,000 to carry out the provisions of this section, which sum shall be available until expended.

"TITLE II—GRANTS FOR CONSTRUCTION OF TREATMENT WORKS

"PURPOSE

"SEC. 201. (a) It is the purpose of this title to require and to assist the development and implementation of waste treatment management plans and practices which will achieve the goals of this Act.

"(b) Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advanced waste treatment techniques.

"(c) To the extent practicable, waste treatment management shall be on an areawide basis and provide control or treatment of all point and nonpoint sources of pollution, including in place or accumulated pollution sources.

"(d) The Administrator shall encourage waste treatment management which results in the construction of revenue producing facilities providing for—

"(1) the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products, or any combination thereof;

"(2) the confined and contained disposal of pollutants not recycled;

"(3) the reclamation of wastewater; and

"(4) the ultimate disposal of sludge in a manner that will not result in environmental hazards.

"(e) The Administrator shall encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges. Such integrated facilities shall be designed and operated to produce revenues in excess of capital and operation and maintenance costs and such revenues shall be used by the designated regional management agency to aid in financing other environmental improvement programs.

"(f) The Administrator shall encourage waste treatment management which combines 'open space' and recreational considerations with such management.

"(g)(1) The Administrator is authorized to make grants to any State, municipality, or intermunicipal or interstate agency for the construction of publicly owned treatment works.

"(2) The Administrator shall not make grants from funds authorized for any fiscal year beginning after June 30, 1974, to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works unless the grant applicant has satisfactorily demonstrated to the Administrator that—

"(A) alternative waste management techniques have been studied and evaluated and the works proposed for grant assistance will provide for the application of the best practicable waste treatment technology over the life of the works consistent with the purposes of this title; and

"(B) as appropriate, the works proposed for grant assistance will take into account and allow to the extent practicable the application of technology at a later date which will provide for the reclaiming or recycling of water or otherwise eliminate the discharge of pollutants.

"(3) The Administrator shall not approve any grant after July 1, 1973, for treatment works under this section unless the applicant shows to the satisfaction of the Administrator that each sewer collection system discharging into such treatment works is not subject to excessive infiltration.

"(4) The Administrator is authorized to make grants to applicants for treatment works grants under this section for such sewer system evaluation studies as may be necessary to carry out the requirements of paragraph (3) of this subsection. Such grants shall be made in accordance with rules and regulations promulgated by the Administrator. Initial rules and regulations shall be promulgated under this paragraph not later than 120 days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972.

"FEDERAL SHARE

"SEC. 202. (a) The amount of any grant for treatment works made under this Act from funds authorized for any fiscal year beginning after June 30, 1971, shall be 75 per centum of the cost of construction thereof (as approved by the Administrator). Any grant (other than for reimbursement) made prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 from any funds authorized for any fiscal year beginning after June 30, 1971, shall, upon the request of the applicant, be increased to the applicable percentage under this section.

"(b) The amount of the grant for any project approved by the Administrator after January 1, 1971, and before July 1, 1971, for the construction of treatment works, the actual erection, building or acquisition of which was not commenced prior to July 1, 1971, shall, upon the request of the applicant, be increased to the applicable percentage under subsection (a) of this section for grants for treatment works from funds for fiscal years beginning after June 30, 1971, with respect to the cost of such actual erection, building, or acquisition. Such increased amount shall be paid from any funds allocated to the State in which the treatment works is located without regard to the fiscal year for which such funds were authorized. Such increased amount shall be paid for such project only if—

"(1) a sewage collection system that is a part of the same total waste treatment system as the treatment works for which such grant was approved is under construction or is to be constructed for use in conjunction with such treatment works, and if the cost of such sewage collection system exceeds the cost of such treatment works, and

"(2) the State water pollution control agency or other appropriate State authority certifies that the quantity of available ground water will be insufficient, inadequate, or unsuitable for public use, including the ecological preservation and recreational use of surface water bodies, unless effluents from publicly-owned treatment works after adequate treatment are returned to the ground water consistent with acceptable technological standards.

"PLANS, SPECIFICATIONS, ESTIMATES, AND PAYMENTS

"SEC. 203. (a) Each applicant for a grant shall submit to the Administrator for his approval, plans, specifications, and estimates for each proposed project for the construction of treatment works for which a grant is applied for under section 201(g)(1) from funds allotted to the State under section 205 and which otherwise meets the requirements of this Act. The Administrator shall act upon such plans, specifications, and estimates as soon as practicable after the same have been submitted, and his approval of any such plans, specifications, and estimates shall be deemed a contractual obligation of the United States for the payment of its proportional contribution to such project.

"(b) The Administrator shall, from time to time as the work progresses, make payments to the recipient of a grant for costs of construction incurred on a project. These payments shall at no time exceed the Federal share of the cost of construction incurred to the date of the voucher covering such payment plus the Federal share of the value of the materials which have been stockpiled in the vicinity of such construction in conformity to plans and specifications for the project.

"(c) After completion of a project and approval of the final voucher by the Administrator, he shall pay out of the appropriate sums the unpaid balance of the Federal share payable on account of such project.

(d) Nothing in this Act shall be construed to require, or to authorize the Administrator to require, that grants under this Act for construction of treatment works be made only for projects which are operable units usable for sewage collection, transportation, storage, waste treatment, or for similar purposes without additional construction.

"LIMITATIONS AND CONDITIONS

"SEC. 204. (a) Before approving grants for any project for any treatment works under section 201(g)(1) the Administrator shall determine—

"(1) that such works are included in any applicable areawide waste treatment management plan developed under section 208 of this Act;

"(2) that such works are in conformity with any applicable State plan under section 303(e) of this Act;

"(3) that such works have been certified by the appropriate State water pollution control agency as entitled to priority over

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such other works in the State in accordance with any applicable State plan under section 303(e) of this Act;

"(4) that the applicant proposing to construct such works agrees to pay the non-Federal costs of such works and has made adequate provisions satisfactory to the Administrator for assuring proper and efficient operation, including the employment of trained management and operations personnel, and the maintenance of such works in accordance with a plan of operation approved by the State water pollution control agency or, as appropriate, the interstate agency, after construction thereof;

"(5) that the size and capacity of such works relate directly to the needs to be served by such works, including sufficient reserve capacity. The amount of reserve capacity provided shall be approved by the Administrator on the basis of a comparison of the cost of constructing such reserves as a part of the works to be funded and the anticipated cost of providing expanded capacity at a date when such capacity will be required;

"(6) that no specification for bids in connection with such works shall be written in such a manner as to contain proprietary, exclusionary, or discriminatory requirements other than those based upon performance, unless such requirements are necessary to test or demonstrate a specific thing or to provide for necessary interchangeability of parts and equipment, or at least two brand names or trade names of comparable quality or utility are listed and are followed by the words 'or equal'.

"(b)(1) Notwithstanding any other provision of this title, the Administrator shall not approve any grant for any treatment works under section 201(g)(1) after March 1, 1973, unless he shall first have determined that the applicant (A) has adopted or will adopt a system of charges to assure that each recipient of waste treatment services within the applicant's jurisdiction, as determined by the Administrator, will pay its proportionate share of the costs of operation and maintenance (including replacement) of any waste treatment services provided by the applicant; (B) has made provision for the payment to such applicant by the industrial users of the treatment works, of that portion of the cost of construction of such treatment works (as determined by the Administrator) which is allocable to the treatment of such industrial wastes to the extent attributable to the Federal share of the cost of construction; and (C) has legal, institutional, managerial, and financial capability to insure adequate construction, operation, and maintenance of treatment works throughout the applicant's jurisdiction, as determined by the Administrator.

"(2) The Administrator shall, within one hundred and eighty days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, and after consultation with appropriate State, interstate, municipal, and intermunicipal agencies, issue guidelines applicable to payment of waste treatment costs by industrial and nonindustrial recipients of waste treatment services which shall establish (A) classes of users of such services, including categories of industrial users; (B) criteria against which to determine the adequacy of charges imposed on classes and categories of users reflecting all factors that influence the cost of waste treatment, including strength, volume, and delivery flow rate characteristics of waste; and (C) model systems and rates of user charges typical of various treatment works serving municipal-industrial communities.

"(3) The grantee shall retain an amount of the revenues derived from the payment of costs by industrial users of waste treatment services, to the extent costs are attributable to the Federal share of eligible project costs provided pursuant to this title as determined by the Administrator, equal to (A) the amount of the non-Federal cost of such project paid by the grantee plus (B) the amount, determined in accordance with regulations promulgated by the Administrator, necessary for future expansion and reconstruction of the project, except that such retained amount shall not exceed 50 per centum of such revenues from such project. All revenues from such project not retained by the grantee shall be deposited by the Administrator in the Treasury as miscellaneous receipts. That portion of the revenues retained by the grantee attributable to clause (B) of the first sentence of this paragraph, together with any interest thereon shall be used solely for the purposes of future expansion and reconstruction of the project.

"(4) Approval by the Administrator of a grant to an interstate agency established by interstate compact for any treatment works shall satisfy any other requirement that such works be authorized by Act of Congress.

"ALLOTMENT

"SEC. 205. (a) Sums authorized to be appropriated pursuant to section 207 for each fiscal year beginning after June 30, 1972, shall be allotted by the Administrator not later than the January 1st immediately preceding the beginning of the fiscal year for which authorized, except that the allotment for fiscal year 1973 shall be made not later than 30 days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Such sums shall be allotted among the States by the Administrator in accordance with regulations promulgated by him, in the ratio that the estimated cost of constructing all needed publicly owned treatment works in each State bears to the estimated cost of construction of all needed publicly owned treatment works in all of the States. For the fiscal years ending June 30, 1973, and June 30, 1974, such ratio shall be determined on the basis of table III of House Public Works Committee Print No. 92-50. For the fiscal year ending June 30, 1975, such ratio shall be determined one-half on the basis of table I of House Public Works Committee Print Numbered 93-28 and one-half on the basis of table II of such print, except that no State shall receive an allotment less than that which it received for the fiscal year ending June 30, 1972, as set forth in table III of such print. Allotments for fiscal years which begin after the fiscal year ending June 30, 1975, shall be made only in accordance with a revised cost estimate made and submitted to Congress in accordance with section 516 (b) of this Act and only after such revised cost estimate shall have been approved by law specifically enacted hereafter.

"(b)(1) Any sums allotted to a State under subsection (a) shall be available for obligation under section 203 on and after the date of such allotment. Such sums shall continue available for obligation in such State for a period of one year after the close of the fiscal year for which such sums are authorized. Any amounts so allotted which are not obligated by the end of such one-year period shall be immediately reallotted by the Administrator, in accordance with regulations promulgated by him, generally on the basis of the ratio used in making the last allotment of sums under this section. Such reallotted sums shall be added to the last allotments made to the States. Any sum made available to a State by reallotment under this subsection shall be in addition to any funds otherwise allotted to such State for grants under this title during any fiscal year.

"(2) Any sums which have been obligated under section 203 and which are released by the payment of the final voucher for the project shall be immediately credited to the State to which such sums were last allotted. Such released sums shall be added to the amounts last allotted to such State and shall be immediately available for obligation in the same manner and to the same extent as such last allotment.

"REIMBURSEMENT AND ADVANCED CONSTRUCTION

"SEC. 206. (a) Any publicly owned treatment works in a State on which construction was initiated after June 30, 1966, but before July 1, 1972, which was approved by the appropriate State water pollution control agency and which the Administrator finds meets the requirements of section 8 of this Act in effect at the time of the initiation of construction shall be reimbursed a total amount equal to the difference between the amount of Federal financial assistance, if any, received under such section 8 for such project and 50 per centum of the cost of such project, or 55 per centum of the project cost where the Administrator also determines that such treatment works was constructed in conformity with a comprehensive metropolitan treatment plan as described in section 8(f) of the Federal Water Pollution Control Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Nothing in this subsection shall result in any such works receiving Federal grants from all sources in excess of 80 per centum of the cost of such project.

"(b) Any publicly owned treatment works constructed with or eligible for Federal financial assistance under this Act in a State between June 30, 1956, and June 30, 1966, which was approved by the State water pollution control agency and which the Administrator finds meets the requirements of section 8 of this Act prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 but which was constructed without assistance under such section 8 or which received such assistance in an amount less than 30 per centum of the cost of such project shall qualify for payments and reimbursement of State or local funds used for such project from sums allocated to such State under this section in an amount which shall not exceed the difference between the amount of such assistance, if any, received for such project and 30 per centum of the cost of such project.

"(c) No publicly owned treatment works shall receive any payment or reimbursement under subsection (a) or (b) of this section unless an application for such assistance is filed with the Administrator within the one year period which begins on the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Any application filed within such one year period may be revised from time to time, as may be necessary.

Editor's Note: Section 206 (c) was amended by Public Law 93-207 as follows: SEC. 2. Notwithstanding the requirements of subsection (c) of section 206 of the Federal Water Pollution Control Act (86 Stat. 838), applications for assistance under section 206 may be filed with the Administrator of the Environmental Protection Agency until January 31, 1974.

"(d) The Administrator shall allocate to each qualified project under subsection (a) of this section each fiscal year for which funds are appropriated under subsection (e) of this section an amount which bears the same ratio to the unpaid balance of the reimbursement due such project as the total of such funds for such year bears to the total unpaid balance of reimbursement due all such approved projects on the date of enactment of such appropriation. The Administrator shall allocate to each qualified project under subsection (b) of this section each fiscal year for which funds are appropriated under subsection (e) of this section an amount which bears the same ratio to the unpaid balance of the reimbursement due such project as the total of such funds

for such year bears to the total unpaid balance of reimbursement due all such approved projects on the date of enactment of such appropriation.

Editor's Note: Section 206 (d) was amended by Public Law 93-207 as follows: SEC. 3. Funds available for reimbursement under Public Law 92-399 shall be allocated in accordance with subsection (d) of section 206 of the Federal Water Pollution Control Act (86 Stat. 838), pro rata among all projects eligible under subsection (a) of such section 206 for which applications have been submitted and approved by the Administrator pursuant to such Act. Notwithstanding the provisions of subsection (d) of such section 206, (1) the Administrator is authorized to make interim payments to each such project for which an application has been approved on the basis of estimates of maximum pro rata entitlement of all applicants under section 206 (a) and (2) for the purpose of determining allocation of sums available under Public Law 92-399, the unpaid balance of reimbursement due such projects shall be computed as of January 31, 1974. Upon completion by the Administrator of his audit and approval of all projects for which an application has been filed under subsection (a) of such section 206, the Administrator shall, within the limits of appropriated funds, allocate to each such qualified project the amount remaining, if any, of its total entitlement. Amounts allocated to projects which are later determined to be in excess of entitlement shall be available for reallocation, until expended, to other qualified projects under subsection (a) of such section 206. In no event, however, shall any payments exceed the Federal share of the cost of construction incurred to the date of the voucher covering such payments plus the Federal share of the value of the materials which have been stockpiled in the vicinity of such construction in conformity to plans and specifications for the project.

"(e) There is authorized to be appropriated to carry out subsection (a) of this section not to exceed $2,600,000,000 and, to carry out subsection (b) of this section, not to exceed $750,000,000. The authorizations contained in this subsection shall be the sole source of funds for reimbursements authorized by this section.

"(f)(1) In any case where all funds allotted to a State under this title have been obligated under section 203 of this Act, and there is construction of any treatment works project without the aid of Federal funds and in accordance with all procedures and all requirements applicable to treatment works projects, except those procedures and requirements which limit construction of projects to those constructed with the aid of previously allotted Federal funds, the Administrator, upon his approval of an application made under this subsection therefor, is authorized to pay the Federal share of the cost of construction of such project when additional funds are allotted to the State under this title if prior to the construction of the project the Administrator approves plans, specifications, and estimates therefor in the same manner as other treatment works projects. The Administrator may not approve an application under this subsection unless an authorization is in effect for the future fiscal year for which the application requests payment, which authorization will insure such payment without exceeding the State's expected allotment from such authorization.

"(2) In determining the allotment for any fiscal year under this title, any treatment works project constructed in accordance with this section and without the aid of Federal funds shall not be considered completed until an application under the provisions of this subsection with respect to such project has been approved by the Administrator, or the availability of funds from which this project is eligible for reimbursement has expired, whichever first occurs.

"AUTHORIZATION

"SEC. 207. There is authorized to be appropriated to carry out this title, other than sections 206 (e), 208 and 209, for the fiscal year ending June 30, 1973, not to exceed $5,000,000,000, for the fiscal year ending June 30, 1974, not to exceed $6,000,000,000, and for the fiscal year ending June 30, 1975, not to exceed $7,000,000,000.

"AREAWIDE WASTE TREATMENT MANAGEMENT

"SEC. 208. (a) For the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans—

"(1) The Administrator, within ninety days after the date of enactment of this Act and after consultation with appropriate Federal, State, and local authorities, shall by regulation publish guidelines for the identification of those areas which, as a result of urban-industrial concentrations or other factors, have substantial water quality control problems.

"(2) The Governor of each State, within sixty days after publication of the guidelines issued pursuant to paragraph (1) of this subsection, shall identify each area within the State which, as a result of urban-industrial concentrations or other factors, has substantial water quality control problems. Not later than one hundred and twenty days following such identification and after consultation with appropriate elected and other officials of local governments having jurisdiction in such areas, the Governor shall designate (A) the boundaries of each such area, and (B) a single representative organization, including elected officials from local governments or their designees, capable of developing effective areawide waste treatment management plans for such area. The Governor may in the same manner at any later time identify any additional area (or modify an existing area) for which he determines areawide waste treatment management to be appropriate, designate the boundaries of such area, and designate an organization capable of developing effective areawide waste treatment management plans for such area.

"(3) With respect to any area which, pursuant to the guidelines published under paragraph (1) of this subsection, is located in two or more States, the Governors of the respective States shall consult and cooperate in carrying out the provisions of paragraph (2), with a view toward designating the boundaries of the interstate area having common water quality control problems and for which areawide waste treatment management plans would be most effective, and toward designating, within one hundred and eighty days after publication of guidelines issued pursuant to paragraph (1) of this subsection, of a single representative organization capable of developing effective areawide waste treatment management plans for such area.

"(4) If a Governor does not act, either by designating or determining not to make a designation under paragraph (2) of this subsection, within the time required by such paragraph, or if, in the case of an interstate area, the Governors of the States involved do not designate a planning organization within the time required by paragraph (3) of this subsection, the chief elected officials of local governments within an area may by agreement designate (A) the boundaries for such an area, and (B) a single representative organization including elected officials from such local governments, or their designees, capable of developing an areawide waste treatment management plan for such area.

"(5) Existing regional agencies may be designated under paragraphs (2), (3), and (4) of this subsection.

"(6) The State shall act as a planning agency for all portions of such State which are not designated under paragraphs (2), (3), or (4) of this subsection.

"(7) Designations under this subsection shall be subject to the approval of the Administrator.

"(b)(1) Not later than one year after the date of designation of any organization under subsection (a) of this section such organization shall have in operation a continuing areawide waste treatment management planning process consistent with section 201 of this Act. Plans prepared in accordance with this process shall contain alternatives for waste treatment management, and be applicable to all wastes generated within the area involved. The initial plan prepared in accordance with such process shall be certified by the Governor and submitted to the Administrator not later than two years after the planning process is in operation.

"(2) Any plan prepared under such process shall include, but not be limited to—

"(A) the identification of treatment works necessary to meet the anticipated municipal and industrial waste treatment needs of the area over a twenty-year period, annually updated (including an analysis of alternative waste treatment systems), including any requirements for the acquisition of land for treatment purposes; the necessary waste water collection and urban storm water runoff systems; and a program to provide the necessary financial arrangements for the development of such treatment works;

"(B) the establishment of construction priorities for such treatment works and time schedules for the initiation and completion of all treatment works;

"(C) the establishment of a regulatory program to—

"(i) implement the waste treatment management requirements of section 201(c),

"(ii) regulate the location, modification, and construction of any facilities within such area which may result in any discharge in such area, and

"(iii) assure that any industrial or commercial wastes discharged into any treatment works in such area meet applicable pretreatment requirements;

"(D) the identification of those agencies necessary to construct, operate, and maintain all facilities required by the plan and otherwise to carry out the plan;

"(E) the identification of the measures necessary to carry out the plan (including financing), the period of time necessary to carry out the plan, the costs of carrying out the plan within such time, and the economic, social, and environmental impact of carrying out the plan within such time;

"(F) a process to (i) identify, if appropriate, agriculturally and silviculturally related nonpoint sources of pollution, including runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

"(G) a process to (i) identify, if appropriate, mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff, and (ii) set forth procedures

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and methods (including land use requirements) to control to the extent feasible such sources;

"(H) a process to (i) identify construction activity related sources of pollution, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

"(I) a process to (i) identify, if appropriate, salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, ground water extraction, and diversion, and (ii) set forth procedures and methods to control such intrusion to the extent feasible where such procedures and methods are otherwise a part of the waste treatment management plan;

"(J) a process to control the disposition of all residual waste generated in such area which could affect water quality; and

"(K) a process to control the disposal of pollutants on land or in subsurface excavations within such area to protect ground and surface water quality.

"(3) Areawide waste treatment management plans shall be certified annually by the Governor or his designee (or Governors or their designees, where more than one State is involved) as being consistent with applicable basin plans and such areawide waste treatment management plans shall be submitted to the Administrator for his approval.

"(4) Whenever the Governor of any State determines (and notifies the Administrator) that consistency with a statewide regulatory program under section 303 so requires, the requirements of clauses (F) through (K) of paragraph (2) of this subsection shall be developed and submitted by the Governor to the Administrator for application to all regions within such State.

"(c)(1) The Governor of each State, in consultation with the planning agency designated under subsection (a) of this section, at the time a plan is submitted to the Administrator, shall designate one or more waste treatment management agencies (which may be an existing or newly created local, regional, or State agency or political subdivision) for each area designated under subsection (a) of this section and submit such designations to the Administrator.

"(2) The Administrator shall accept any such designation, unless, within 120 days of such designation, he finds that the designated management agency (or agencies) does not have adequate authority—

"(A) to carry out appropriate portions of an areawide waste treatment management plan developed under subsection (b) of this section;

"(B) to manage effectively waste treatment works and related facilities serving such area in conformance with any plan required by subsection (b) of this section;

"(C) directly or by contract, to design and construct new works, and to operate and maintain new and existing works as required by any plan developed pursuant to subsection (b) of this section;

"(D) to accept and utilize grants, or other funds from any source, for waste treatment management purposes;

"(E) to raise revenues, including the assessment of waste treatment charges;

"(F) to incur short- and long-term indebtedness;

"(G) to assure in implementation of an areawide waste treatment management plan that each participating community pays its proportionate share of treatment costs;

"(H) to refuse to receive any wastes from any municipality or subdivision thereof, which does not comply with any provisions of an approved plan under this section applicable to such area; and

"(I) to accept for treatment industrial wastes.

"(d) After a waste treatment management agency having the authority required by subsection (c) has been designated under such subsection for an area and a plan for such area has been approved under subsection (b) of this section, the Administrator shall not make any grant for construction of a publicly owned treatment works under section 201(g)(1) within such area except to such designated agency and for works in conformity with such plan.

"(e) No permit under section 402 of this Act shall be issued for any point source which is in conflict with a plan approved pursuant to subsection (b) of this section.

"(f)(1) The Administrator shall make grants to any agency designated under subsection (a) of this section for payment of the reasonable costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

"(2) The amount granted to any agency under paragraph (1) of this subsection shall be 100 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section for each of the first years ending on June 30, 1973, June 30, 1974, and June 30, 1975, and shall not exceed 75 per centum of such costs in each succeeding fiscal year.

"(3) Each applicant for a grant under this subsection shall submit to the Administrator for his approval each proposal for which a grant is applied for under this subsection. The Administrator shall act upon such proposal as soon as practicable after it has been submitted, and his approval of that proposal shall be deemed a contractual obligation of the United States for the payment of its contribution to such proposal. There is authorizd to be appropriated to carry out this subsection not to exceed $50,000,000 for the fiscal year ending June 30, 1973, not to exceed $100,000,000 for the fiscal year ending June 30, 1974, and not to exceed $150,000,000 for the fiscal year ending June 30, 1975.

"(g) The Administrator is authorized, upon request of the Governor or the designated planning agency, and without reimbursement, to consult with, and provide technical assistance to, any agency designated under subsection (a) of this section in the development of areawide waste treatment management plans under subsection (b) of this section.

"(h)(1) The Secretary of the Army, acting through the Chief of Engineers, in cooperation with the Administrator is authorized and directed, upon request of the Governor or the designated planning organization, to consult with, and provide technical assistance to, any agency designed under subsection (a) of this section in developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

"(2) There is authorized to be appropriated to the Secretary of the Army, to carry out this subsection, not to exceed $50,000,000 per fiscal year for the fiscal years ending June 30, 1973, and June 30, 1974.

"BASIN PLANNING

"SEC. 209 (a) The President, acting through the Water Resources Council, shall, as soon as practicable, prepare a Level B plan under the Water Resources Planning Act for all basins in the United States. All such plans shall be completed not later than January 1, 1980, except that priority in the preparation of such plans shall be given to those basins and portions thereof which are within those areas designated under paragraphs (2), (3), and (4) of subsection (a) of section 208 of this Act.

"(b) The President, acting through the Water Resources Council, shall report annually to Congress on progress being made in carrying out this section. The first such report shall be submitted not later than January 31, 1973.

"(c) There is authorized to be appropriated to carry out this section not to exceed $200,000,000.

"ANNUAL SURVEY

"SEC. 210. The Administrator shall annually make a survey to determine the efficiency of the operation and maintenance of treatment works constructed with grants made under this Act, as compared to the efficiency planned at the time the grant was made. The results of such annual survey shall be included in the report required under section 516(a) of this Act.

"SEWAGE COLLECTION SYSTEMS

"SEC. 211. No grant shall be made for a sewage collection system under this title unless such grant (1) is for replacement or major rehabilitation of an existing collection system and is necessary to the total integrity and performance of the waste treatment works servicing such community, or (2) is for a new collection system in an existing community with sufficient existing or planned capacity adequately to treat such collected sewage and is consistent with section 201 of this Act.

"DEFINITIONS

"SEC. 212. As used in this title—

"(1) The term 'construction' means any one or more of the following: preliminary planning to determine the feasibility of treatment works, engineering, architectural, legal, fiscal, or economic investigations or studies, surveys, designs, plans, working drawings, specifications, procedures, or other necessary actions, erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works, or the inspection or supervision of any of the foregoing items.

"(2)(A) The term 'treatment works' means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature to implement section 201 of this Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment, and their appurtenances; extensions, improvements, remodeling, additions, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment.

"(B) In addition to the definition contained in subparagraph (A) of this paragraph, 'treatment works' means any other method or system for preventing, abating, reducing, storing, treating, separating,

or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems. Any application for construction grants which includes wholly or in part such methods or systems shall, in accordance with guidelines published by the Administrator pursuant to subparagraph (C) of this paragraph, contain adequate data and analysis demonstrating such proposal to be, over the life of such works, the most cost efficient alternative to comply with sections 301 or 302 of this Act, or the requirements of section 201 of this Act.

"(C) For the purposes of subparagraph (B) of this paragraph, the Administrator shall, within one hundred and eighty days after the date of enactment of this title, publish and thereafter revise no less often than annually, guidelines for the evaluation of methods, including cost-effective analysis, described in subparagraph (B) of this paragraph.

"(3) The term 'replacement' as used in this title means those expenditures for obtaining and installing equipment, accessories, or appurtenances during the useful life of the treatment works necessary to maintain the capacity and performance for which such works are designed and constructed.

"LOAN GUARANTEES FOR CONSTRUCTION OF TREATMENT WORKS

"SEC. 213. (a) Subject to the conditions of this section and to such terms and conditions as the Administrator determines to be necessary to carry out the purposes of this title, the Administrator is authorized to guarantee, and to make commitments to guarantee, the principal and interest (including interest accruing between the date of default and the date of the payment in full of the guarantee) of any loan, obligation, or participation therein of any State, municipality, or intermunicipal or interstate agency issued directly and exclusively to the Federal Financing Bank to finance that part of the cost of any grant-eligible project for the construction of publicly owned treatment works not paid for with Federal financial assistance under this title (other than this section), which project the Administrator has determined to be eligible for such financial assistance under this title, including, but not limited to, projects eligible for reimbursement under section 206 of this title.

"(b) No guarantee, or commitment to make a guarantee, may be made pursuant to this section—

"(1) unless the Administrator certifies that the issuing body is unable to obtain on reasonable terms sufficient credit to finance its actual needs without such guarantee; and

"(2) unless the Administrator determines that there is a reasonable assurance of repayment of the loan, obligation, or participation therein.

A determination of whether financing is available at reasonable rates shall be made by the Secretary of the Treasury with relationship to the current average yield on outstanding marketable obligations of municipalities of comparable maturity.

"(c) The Administrator is authorized to charge reasonable fees for the investigation of an application for a guarantee and for the issuance of a commitment to make a guarantee.

"(d) The Administrator, in determining whether there is a reasonable assurance of repayment, may require a commitment which would apply to such repayment. Such commitment may include, but not be limited to, (1) all or any portion of the funds retained by such grantee under section 204(b)(3) of this Act, and (2) any funds received by such grantee from the amounts appropriated under section 206 of this Act.".

"TITLE III—STANDARDS AND ENFORCEMENT

"EFFLUENT LIMITATIONS

"SEC. 301. (a) Except as in compliance with this section and sections 302, 306, 307, 318, 402, and 404 of this Act, the discharge of any pollutant by any person shall be unlawful.

"(b) In order to carry out the objective of this Act there shall be achieved—

"(1)(A) not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, (i) which shall require the application of the best practicable control technology currently available as defined by the Administrator pursuant to section 304(b) of this Act, or (ii) in the case of a discharge into a publicly owned treatment works which meets the requirements of subparagraph (B) of this paragraph, which shall require compliance with any applicable pretreatment requirements and any requirements under section 307 of this Act; and

"(B) for publicly owned treatment works in existence on July 1, 1977, or approved pursuant to section 203 of this Act prior to June 30, 1974 (for which construction must be completed within four years of approval), effluent limitations based upon secondary treatment as defined by the Administrator pursuant to section 304(d)(1) of this Act; or,

"(C) not later than July 1, 1977, any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedules of compliance, established pursuant to any State law or regulations (under authority preserved by section 510) or any other Federal law or regulation, or required to implement any applicable water quality standard established pursuant to this Act.

"(2)(A) not later than July 1, 1983, effluent limitations for categories and classes of point sources, other than publicly owned treatment works, which (i) shall require application of the best available technology economically achievable for such category or class, which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants, as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act, which such effluent limitations shall require the elimination of discharges of all pollutants if the Administrator finds, on the basis of information available to him (including information developed pursuant to section 315), that such elimination is technologically and economically achievable for a category or class of point sources as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act, or (ii) in the case of the introduction of a pollutant into a publicly owned treatment works which meets the requirements of subparagraph (B) of this paragraph, shall require compliance with any applicable pretreatment requirements and any other requirement under section 307 of this Act; and

"(B) not later than July 1, 1983, compliance by all publicly owned treatment works with the requirements set forth in section 201(g)(2)(A) of this Act.

"(c) The Administrator may modify the requirements of subsection (b)(2)(A) of this section with respect to any point source for which a permit application is filed after July 1, 1977, upon a showing by the owner or operator of such point source satisfactory to the Administrator that such modified requirements (1) will represent the maximum use of technology within the economic capability of the owner or operator; and (2) will result in reasonable further progress toward the elimination of the discharge of pollutants.

"(d) Any effluent limitation required by paragraph (2) of subsection (b) of this section shall be reviewed at least every five years and, if appropriate, revised pursuant to the procedure established under such paragraph.

"(e) Effluent limitations established pursuant to this section or section 302 of this Act shall be applied to all point sources of discharge of pollutants in accordance with the provisions of this Act.

"(f) Notwithstanding any other provisions of this Act it shall be unlawful to discharge any radiological, chemical, or biological warfare agent or high-level radioactive waste into the navigable waters.

"WATER QUALITY RELATED EFFLUENT LIMITATIONS

"SEC. 302. (a) Whenever, in the judgment of the Administrator, discharges of pollutants from a point source or group of point sources, with the application of effluent limitations required under section 301(b)(2) of this Act, would interfere with the attainment or maintenance of that water quality in a specific portion of the navigable waters which shall assure protection of public water supplies, agricultural and industrial uses, and the protection and propagation of a balanced population of shellfish, fish and wildlife, and allow recreational activities in and on the water, effluent limitations (including alternative effluent control strategies) for such point source or sources shall be established which can reasonably be expected to contribute to the attainment or maintenance of such water quality.

"(b)(1) Prior to establishment of any effluent limitation pursuant to subsection (a) of this section, the Administrator shall issue notice of intent to establish such limitation and within ninety days of such notice hold a public hearing to determine the relationship of the economic and social costs of achieving any such limitation or limitations, including any economic or social dislocation in the affected community or communities, to the social and economic benefits to be obtained (including the attainment of the objective of this Act) and to determine whether or not such effluent limitations can be implemented with available technology or other alternative control strategies.

"(2) If a person affected by such limitation demonstrates at such hearing that (whether or not such technology or other alternative control strategies are available) there is no reasonable relationship between the economic and social costs and the benefits to be obtained (including attainment of the objective of this Act), such limitation shall not become effective and the Administrator shall adjust such limitation as it applies to such person.

"(c) The establishment of effluent limitations under this section shall not operate to delay the application of any effluent limitation established under section 301 of this Act.

"WATER QUALITY STANDARDS AND IMPLEMENTATION PLANS

"SEC. 303. (a)(1) In order to carry out the purpose of this Act, any water quality standard applicable to interstate waters which was adopted by any State and submitted to, and approved by, or is awaiting

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approval by, the Administrator pursuant to this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, shall remain in effect unless the Administrator determined that such standard is not consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. If the Administrator makes such a determination he shall, within three months after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, notify the State and specify the changes needed to meet such requirements. If such changes are not adopted by the State within ninety days after the date of such notification, the Administrator shall promulgate such changes in accordance with subsection (b) of this section.

"(2) Any State which, before the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, has adopted, pursuant to its own law, water quality standards applicable to intrastate waters shall submit such standards to the Administrator within thirty days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Each such standard shall remain in effect, in the same manner and to the same extent as any other water quality standard established under this Act unless the Administrator determines that such standard is inconsistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. If the Administrator makes such a determination he shall not later than the one hundred and twentieth day after the date of submission of such standards, notify the State and specify the changes needed to meet such requirements. If such changes are not adopted by the State within ninety days after such notification, the Administrator shall promulgate such changes in accordance with subsection (b) of this section.

"(3)(A) Any State which prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 has not adopted pursuant to its own laws water quality standards applicable to intrastate waters shall, not later than one hundred and eighty days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, adopt and submit such standards to the Administrator.

"(B) If the Administrator determines that any such standards are consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, he shall approve such standards.

"(C) If the Administrator determines that any such standards are not consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, he shall, not later than the ninetieth day after the date of submission of such standards, notify the State and specify the changes to meet such requirements. If such changes are not adopted by the State within ninety days after the date of notification, the Administrator shall promulgate such standards pursuant to subsection (b) of this section.

"(b)(1) The Administrator shall promptly prepare and publish proposed regulations setting forth water quality standards for a State in accordance with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, if—

"(A) the State fails to submit water quality standards within the times prescribed in subsection (a) of this section,

"(B) a water quality standard submitted by such State under subsection (a) of this section is determined by the Administrator not to be consistent with the applicable requirements of subsection (a) of this section.

"(2) The Administrator shall promulgate any water quality standard published in a proposed regulation not later than one hundred and ninety days after the date he publishes any such proposed standard, unless prior to such promulgation, such State has adopted a water quality standard which the Administrator determines to be in accordance with subsection (a) of this section.

"(c)(1) The Governor of a State or the State water pollution control agency of such State shall from time to time (but at least once each three year period beginning with the date of enactment of the Federal Water Pollution Control Act Amendments of 1972) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. Results of such review shall be made available to the Administrator.

"(2) Whenever the State revises or adopts a new standard, such revised or new standard shall be submitted to the Administrator. Such revised or new water quality standard shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses. Such standards shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act. Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation.

"(3) If the Administrator, within sixty days after the date of submission of the revised or new standard, determines that such standard meets the requirements of this Act, such standard shall thereafter be the water quality standard for the applicable waters of that State. If the Administrator determines that any such revised or new standard is not consistent with the applicable requirements of this Act, he shall not later than the ninetieth day after the date of submission of such standard notify the State and specify the changes to meet such requirements. If such changes are not adopted by the State within ninety days after the date of notification, the Administrator shall promulgate such standard pursuant to paragraph (4) of this subsection.

"(4) The Administrator shall promptly prepare and publish proposed regulations setting forth a revised or new water quality standard for the navigable waters involved—

"(A) if a revised or new water quality standard submitted by such State under paragraph (3) of this subsection for such waters is determined by the Administrator not to be consistent with the applicable requirements of this Act, or

"(B) in any case where the Administrator determines that a revised or new standard is necessary to meet the requirements of this Act.

The Administrator shall promulgate any revised or new standard under this paragraph not later than ninety days after he publishes such proposed standards, unless prior to such promulgation, such State has adopted a revised or new water quality standard which the Administrator determines to be in accordance with this Act.

"(d)(1)(A) Each State shall identify those waters within its boundaries for which the effluent limitations required by section 301(b)(1)(A) and section 301(b)(1)(B) are not stringent enough to implement any water quality standard applicable to such waters. The State shall establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters.

"(B) Each State shall identify those waters or parts thereof within its boundaries for which controls on thermal discharges under section 301 are not stringent enough to assure protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife.

"(C) Each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculation. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

"(D) Each State shall estimate for the waters identified in paragraph (1)(B) of this subsection the total maximum daily thermal load required to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife. Such estimates shall take into account the normal water temperatures, flow rates, seasonal variations, existing sources of heat input, and the dissipative capacity of the identified waters or parts thereof. Such estimates shall include a calculation of the maximum heat input that can be made into each such part and shall include a margin of safety which takes into account any lack of knowledge concerning the development of thermal water quality criteria for such protection and propagation in the identified waters or parts thereof.

"(2) Each State shall submit to the Administrator from time to time, with the first such submission not later than one hundred and eighty days after the date of publication of the first identification of pollutants under section 304(a)(2)(D), for his approval the waters identified and the loads established under paragraphs (1)(A), (1)(B), (1)(C), and (1)(D) of this subsection. The Administrator shall either approve or disapprove such identification and load not later than thirty days after the date of submission. If the Administrator approves such identification and load, such State shall incorporate them into its current plan under subsection (e) of this section. If the Administrator disapproves such identification and load, he shall not later than thirty days after the date of such disapproval identify such waters in such State and establish such loads for such waters as he determines necessary to implement the water quality standards applicable to such waters and upon such identification and establishment the State shall incorporate them into its current plan under subsection (e) of this section.

"(3) For the specific purpose of developing information, each State shall identify all waters within its boundaries which it has not identified under paragraph (1)(A) and (1)(B) of this subsection and estimate for such waters the total maximum daily load with seasonal variations and margins of safety, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculation and for thermal discharges, at a level that would assure protection and propagation of a balanced indigenous population of fish, shellfish and wildlife.

"(e)(1) Each State shall have a continuing planning process approved under paragraph (2) of this subsection which is consistent with this Act.

"(2) Each State shall submit not later than 120 days after the date of the enactment of the Water Pollution Control Amendments of 1972 to the Administrator for his approval a proposed continuing planning process which is consistent with this Act. Not later than thirty days after the date of submission of such a process the Administrator shall either approve or disapprove such process. The Administrator shall from time to time review each State's approved planning process for the purpose of insuring that such planning process is at all times consistent with this Act. The Administrator shall not approve any State permit program under title IV of this Act for any State which does not have an approved continuing planning process under this section.

"(3) The Administrator shall approve any continuing planning process submitted to him under this section which will result in plans for all navigable waters within such State, which include, but are not limited to, the following:

"(A) effluent limitations and schedules of compliance at least as stringent as those required by section 301(b)(1), section 301(b)(2), section 306, and section 307, and at least as stringent as any requirements contained in any applicable water quality standard in effect under authority of this section;

"(B) the incorporation of all elements of any applicable area-wide waste management plans under section 208, and applicable basin plans under section 209 of this Act;

"(C) total maximum daily load for pollutants in accordance with subsection (d) of this section;

"(D) procedures for revision;

"(E) adequate authority for intergovernmental cooperation;

"(F) adequate implementation, including schedules of compliance, for revised or new water quality standards, under subsection (c) of this section;

"(G) controls over the disposition of all residual waste from any water treatment processing;

"(H) an inventory and ranking, in order of priority, of needs for construction of waste treatment works required to meet the applicable requirements of sections 301 and 302.

"(f) Nothing in this section shall be construed to affect any effluent limitation, or schedule of compliance required by any State to be implemented prior to the dates set forth in sections 301(b)(1) and 301(b)(2) nor to preclude any State from requiring compliance with any effluent limitation or schedule of compliance at dates earlier than such dates.

"(g) Water quality standards relating to heat shall be consistent with the requirements of section 316 of this Act.

"(h) For the purposes of this Act the term 'water quality standards' includes thermal water quality standards.

"INFORMATION AND GUIDELINES

"SEC. 304. (a)(1) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall develop and publish, within one year after the date of enactment of this title (and from time to time thereafter revise) criteria for water quality accurately reflecting the latest scientific knowledge (A) on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation which may be expected from the presence of pollutants in any body of water, including ground water; (B) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (C) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and rates of organic and inorganic sedimentation for varying types of receiving waters.

"(2) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall develop and publish, within one year after the date of enactment of this title (and from time to time thereafter revise) information (A) on the factors necessary to restore and maintain the chemical, physical, and biological integrity of all navigable waters, ground waters, waters of the contiguous zone, and the oceans; (B) on the factors necessary for the protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving waters and to allow recreational activities in and on the water; and (C) on the measurement and classification of water quality; and (D) for the purpose of section 303, on and the identification of pollutants suitable for maximum daily load measurement correlated with the achievement of water quality objectives.

"(3) Such criteria and information and revisions thereof shall be issued to the States and shall be published in the Federal Register and otherwise made available to the public.

"(b) For the purpose of adopting or revising effluent limitations under this Act the Administrator shall, after consultation with appropriate Federal and State agencies and other interested persons, publish within one year of enactment of this title, regulations, providing guidelines for effluent limitations, and, at least annually thereafter, revise, if appropriate, such regulations. Such regulations shall—

"(1)(A) identify, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, the degree of effluent reduction attainable through the application of the best practicable control technology currently available for classes and categories of point sources (other than publicly owned treatment works); and

"(B) specify factors to be taken into account in determining the control measures and practices to be applicable to point sources (other than publicly owned treatment works) within such categories or classes. Factors relating to the assessment of best practicable control technology currently available to comply with subsection (b)(1) of section 301 of this Act shall include consideration of the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application, and shall also take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate;

"(2)(A) identify, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, the degree of effluent reduction attainable through the application of the best control measures and practices achievable including treatment techniques, process and procedure innovations, operating methods, and other alternatives for classes and categories of point sources (other than publicly owned treatment works); and

"(B) specify factors to be taken into account in determining the best measures and practices available to comply with subsection (b)(2) of section 301 of this Act to be applicable to any point source (other than publicly owned treatment works) within such categories or classes. Factors relating to the assessment of best available technology shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such effluent reduction, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate; and

"(3) identify control measures and practices available to eliminate the discharge of pollutants from categories and classes of point sources, taking into account the cost of achieving such elimination of the discharge of pollutants.

"(c) The Administrator, after consultation, with appropriate Federal and State agencies and other interested persons, shall issue to the States and appropriate water pollution control agencies within 270 days after enactment of this title (and from time to time thereafter) information on the processes, procedures, or operating methods which result in the elimination or reduction of the discharge of pollutants to implement standards of performance under section 306 of this Act. Such information shall include technical and other data, including costs, as are available on alternative methods of elimination or reduction of the discharge of pollutants. Such information, and revisions thereof, shall be published in the Federal Register and otherwise shall be made available to the public.

"(d)(1) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall publish within sixty days after enactment of this title (and from time to time thereafter) information, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, on the degree of effluent reduction attainable through the application of secondary treatment.

"(2) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall publish within nine months after the date of enactment of this title (and from time to time thereafter) information on alternative waste treatment management techniques and systems available to implement section 201 of this Act.

"(e) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall issue to appropriate Federal agencies, the States, water pollution control agencies, and agencies designated under section 208 of this Act, within one year after the effective date of this subsection (and from time to time thereafter) information including (1) guidelines for identifying and evaluating the nature and extent of nonpoint sources of pollutants, and (2) processes, procedures, and methods to control pollution resulting from—

"(A) agricultural and silvicultural activities, including runoff from fields and crop and forest lands;

"(B) mining activities, including runoff and siltation from new, currently operating, and abandoned surface and underground mines;

"(C) all construction activity, including runoff from the facilities resulting from such construction;

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"(D) the disposal of pollutants in wells or in subsurface excavations;

"(E) salt water intrusion resulting from reductions of fresh water flow from any cause, including extraction of ground water, irrigation, obstruction, and diversion; and

"(F) changes in the movement, flow, or circulation of any navigable waters or ground waters, including changes caused by the construction of dams, levees, channels, causeways, or flow diversion facilities.

Such information and revisions thereof shall be published in the Federal Register and otherwise made available to the public.

"(f)(1) For the purpose of assisting States in carrying out programs under section 402 of this Act, the Administrator shall publish, within one hundred and twenty days after the date of enactment of this title, and review at least annually thereafter and, if appropriate, revise guidelines for pretreatment of pollutants which he determines are not susceptible to treatment by publicly owned treatment works. Guidelines under this subsection shall be established to control and prevent the discharge into the navigable waters, the contiguous zone, or the ocean (either directly or through publicly owned treatment works) of any pollutant which interferes with, passes through, or otherwise is incompatible with such works.

"(2) When publishing guidelines under this subsection, the Administrator shall designate the category or categories of treatment works to which the guidelines shall apply.

"(g) The Administrator shall, within one hundred and eighty days from the date of enactment of this title, promulgate guidelines establishing test procedures for the analysis of pollutants that shall include the factors which must be provided in any certification pursuant to section 401 of this Act or permit application pursuant to section 402 of this Act.

"(h) The Administrator shall (1) within sixty days after the enactment of this title promulgate guidelines for the purpose of establishing uniform application forms and other minimum requirements for the acquisition of information from owners and operators of point sources of discharge subject to any State program under section 402 of this Act, and (2) within sixty days from the date of enactment of this title promulgate guidelines establishing the minimum procedural and other elements of any State program under section 402 of this Act which shall include:

"(A) monitoring requirements;

"(B) reporting requirements (including procedures to make information available to the public);

"(C) enforcement provisions; and

"(D) funding, personnel qualifications, and manpower requirements (including a requirement that no board or body which approves permit applications or portions thereof shall include, as a member, any person who receives, or has during the previous two years received, a significant portion of his income directly or indirectly from permit holders or applicants for a permit).

"(i) The Administrator shall, within 270 days after the effective date of this subsection (and from time to time thereafter), issue such information on methods, procedures, and processes as may be appropriate to restore and enhance the quality of the Nation's publicly owned fresh water lakes.

"(j)(1) The Administrator shall, within six months from the date of enactment of this title, enter into agreements with the Secretary of Agriculture, the Secretary of the Army, and the Secretary of the Interior to provide for the maximum utilization of the appropriate programs authorized under other Federal law to be carried out by such Secretaries for the purpose of achieving and maintaining water quality through appropriate implementation of plans approved under section 208 of this Act.

"(2) The Administrator, pursuant to any agreement under paragraph (1) of this subsection is authorized to transfer to the Secretary of Agriculture, the Secretary of the Army, or the Secretary of the Interior any funds appropriated under paragraph (3) of this subsection to supplement any funds otherwise appropriated to carry out appropriate programs authorized to be carried out by such Secretaries.

"(3) There is authorized to be appropriated to carry out the provisions of this subsection, $100,000,000 per fiscal year for the fiscal year ending June 30, 1973, and the fiscal year ending June 30, 1974.

"WATER QUALITY INVENTORY

"SEC. 305. (a) The Administrator, in cooperation with the States and with the assistance of appropriate Federal agencies, shall prepare a report to be submitted to the Congress on or before January 1, 1974, which shall—

"(1) describe the specific quality, during 1972, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, of all navigable waters and the waters of the contiguous zone;

"(2) include an inventory of all point sources of discharge (based on a qualitative and quantitative analysis of discharges) of pollutants, into all navigable waters and the waters of the contiguous zone; and

"(3) identify specifically those navigable waters, the quality of which—

"(A) is adequate to provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allow recreational activities in and on the water;

"(B) can reasonably be expected to attain such level by 1977 or 1983; and

"(C) can reasonably be expected to attain such level by any later date.

"(b)(1) Each State shall prepare and submit to the Administrator by January 1, 1975, and shall bring up to date each year thereafter, a report which shall include—

"(A) a description of the water quality of all navigable waters in such State during the preceding year, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, correlated with the quality of water required by the objective of this Act (as identified by the Administrator pursuant to criteria published under section 304(a) of this Act) and the water quality described in subparagraph (B) of this paragraph;

"(B) an analysis of the extent to which all navigable waters of such State provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water;

"(C) an analysis of the extent to which the elimination of the discharge of pollutants and a level of water quality which provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water, have been or will be achieved by the requirements of this Act, together with recommendations as to additional action necessary to achieve such objectives and for what waters such additional action is necessary;

"(D) an estimate of (i) the environmental impact, (ii) the economic and social costs necessary to achieve the objective of this Act in such State, (iii) the economic and social benefits of such achievement, and (iv) an estimate of the date of such achievement; and

"(E) a description of the nature and extent of nonpoint sources of pollutants, and recommendations as to the programs which must be undertaken to control each category of such sources, including an estimate of the costs of implementing such programs.

"(2) The Administrator shall transmit such State reports, together with an analysis thereof, to Congress on or before October 1, 1975, and annually thereafter.

"NATIONAL STANDARDS OF PERFORMANCE

"SEC. 306. (a) For purposes of this section:

"(1) The term 'standard of performance' means a standard for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction which the Administrator determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.

"(2) The term 'new source' means any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance under this section which will be applicable to such source, if such standard is thereafter promulgated in accordance with this section.

"(3) The term 'source' means any building, structure, facility, or installation from which there is or may be the discharge of pollutants.

"(4) The term 'owner or operator' means any person who owns, leases, operates, controls, or supervises a source.

"(5) The term 'construction' means any placement, assembly, or installation of facilities or equipment (including contractual obligations to purchase such facilities or equipment) at the premises where such equipment will be used, including preparation work at such premises.

"(b)(1)(A) The Administrator shall, within ninety days after the date of enactment of this title publish (and from time to time thereafter shall revise) a list of categories of sources, which shall, at the minimum, include:

"pulp and paper mills;
"paperboard, builders paper and board mills;
"meat product and rendering processing;
"dairy product processing;
"grain mills;
"canned and preserved fruits and vegetables processing;
"canned and preserved seafood processing;
"sugar processing;
"textile mills;
"cement manufacturing;
"feedlots;
"electroplating;
"organic chemicals manufacturing;
"inorganic chemicals manufacturing;

"plastic and synthetic materials manufacturing:
"soap and detergent manufacturing;
"fertilizer manufacturing;
"petroleum refining;
"iron and steel manufacturing;
"nonferrous metals manufacturing;
"phosphate manufacturing;
"steam electric powerplants;
"ferroalloy manufacturing;
"leather tanning and finishing;
"glass and asbestos manufacturing;
"rubber processing; and
"timber products processing.

"(B) As soon as practicable, but in no case more than one year, after a category of sources is included in a list under subparagraph (A) of this paragraph, the Administrator shall propose and publish regulations establishing Federal standards of performance for new sources within such category. The Administrator shall afford interested persons an opportunity for written comment on such proposed regulations. After considering such comments, he shall promulgate, within one hundred and twenty days after publication of such proposed regulations, such standards with such adjustments as he deems appropriate. The Administrator shall, from time to time, as technology and alternatives change, revise such standards following the procedure required by this subsection for promulgation of such standards. Standards of performance, or revisions thereof, shall become effective upon promulgation. In establishing or revising Federal standards of performance for new sources under this section, the Administrator shall take into consideration the cost of achieving such effluent reduction, and any non-water quality environmental impact and energy requirements.

"(2) The Administrator may distinguish among classes, types, and sizes within categories of new sources for the purpose of establishing such standards and shall consider the type of process employed (including whether batch or continuous).

"(3) The provisions of this section shall apply to any new source owned or operated by the United States.

"(c) Each State may develop and submit to the Administrator a procedure under State law for applying and enforcing standards of performance for new sources located in such State. If the Administrator finds that the procedure and the law of any State require the application and enforcement of standards of performance to at least the same extent as required by this section, such State is authorized to apply and enforce such standards of performance (except with respect to new sources owned or operated by the United States).

"(d) Notwithstanding any other provision of this Act, any point source the construction of which is commenced after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 and which is so constructed as to meet all applicable standards of performance shall not be subject to any more stringent standard of performance during a ten-year period beginning on the date of completion of such construction or during the period of depreciation or amortization of such facility for the purposes of section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first.

"(e) After the effective date of standards of performance promulgated under this section, it shall be unlawful for any owner or operator of any new source to operate such source in violation of any standard of performance applicable to such source.

"TOXIC AND PRETREATMENT EFFLUENT STANDARDS

"SEC. 307. (a)(1) The Administrator shall, within ninety days after the date of enactment of this title, publish (and from time to time thereafter revise) a list which includes any toxic pollutant or combination of such pollutants for which an effluent standard (which may include a prohibition of the discharge of such pollutants or combination of such pollutants) will be established under this section. The Administrator in publishing such list shall take into account the toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms and the nature and extent of the effect of the toxic pollutant on such organisms.

"(2) Within one hundred and eighty days after the date of publication of any list, or revision thereof, containing toxic pollutants or combination of pollutants under paragraph (1) of this subsection, the Administrator, in accordance with section 553 of title 5 of the United States Code, shall publish a proposed effluent standard (or a prohibition) for such pollutant or combination of pollutants which shall take into account the toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms and the nature and extent of the effect of the toxic pollutant on such organisms, and he shall publish a notice for a public hearing on such proposed standard to be held within thirty days. As soon as possible after such hearing, but not later than six months after publication of the proposed effluent standard (or prohibition), unless the Administrator finds, on the record, that a modification of such proposed standard (or prohibition) is justified based upon a preponderance of evidence adduced at such hearings, such standard (or prohibition) shall be promulgated.

"(3) If after a public hearing the Administrator finds that a modification of such proposed standard (or prohibition) is justified, a revised effluent standard (or prohibition) for such pollutant or combination of pollutants shall be promulgated immediately. Such standard (or prohibition) shall be reviewed and, if appropriate, revised at least every three years.

"(4) Any effluent standard promulgated under this section shall be at that level which the Administrator determines provides an ample margin of safety.

"(5) When proposing or promulgating any effluent standard (or prohibition) under this section, the Administrator shall designate the category or categories of sources to which the effluent standard (or prohibition) shall apply. Any disposal of dredged material may be included in such a category of sources after consultation with the Secretary of the Army.

"(6) Any effluent standard (or prohibition) established pursuant to this section shall take effect on such date or dates as specified in the order promulgating such standard, but in no case more than one year from the date of such promulgation.

"(7) Prior to publishing any regulations pursuant to this section the Administrator shall, to the maximum extent practicable within the time provided, consult with appropriate advisory committees, States, independent experts, and Federal departments and agencies.

"(b)(1) The Administrator shall, within one hundred and eighty days after the date of enactment of this title and from time to time thereafter, publish proposed regulations establishing pretreatment standards for introduction of pollutants into treatment works (as defined in section 212 of this Act) which are publicly owned for those pollutants which are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works. Not later than ninety days after such publication, and after opportunity for public hearing, the Administrator shall promulgate such pretreatment standards. Pretreatment standards under this subsection shall specify a time for compliance not to exceed three years from the date of promulgation and shall be established to prevent the discharge of any pollutant through treatment works (as defined in section 212 of this Act) which are publicly owned, which pollutant interferes with, passes through, or otherwise is incompatible with such works.

"(2) The Administrator shall, from time to time, as control technology, processes, operating methods, or other alternatives change, revise such standards following the procedure established by this subsection for promulgation of such standards.

"(3) When proposing or promulgating any pretreatment standard under this section, the Administrator shall designate the category or categories of sources to which such standard shall apply.

"(4) Nothing in this subsection shall affect any pretreatment requirement established by any State or local law not in conflict with any pretreatment standard established under this subsection.

"(c) In order to insure that any source introducing pollutants into a publicly owned treatment works, which source would be a new source subject to section 306 if it were to discharge pollutants, will not cause a violation of the effluent limitations established for any such treatment works, the Administrator shall promulgate pretreatment standards for the category of such sources simultaneously with the promulgation of standards of performance under section 306 for the equivalent category of new sources. Such pretreatment standards shall prevent the discharge of any pollutant into such treatment works, which pollutant may interfere with, pass through, or otherwise be incompatible with such works.

"(d) After the effective date of any effluent standard or prohibition or pretreatment standard promulgated under this section, it shall be unlawful for any owner or operator of any source to operate any source in violation of any such effluent standard or prohibition or pretreatment standard.

"INSPECTIONS, MONITORING AND ENTRY

"SEC. 308. (a) Whenever required to carry out the objective of this Act, including but not limited to (1) developing or assisting in the development of any effluent limitation, or other limitation, prohibition, or effluent standard, pretreatment standard, or standard of performance under this Act; (2) determining whether any person is in violation of any such effluent limitation, or other limitation, prohibition or effluent standard, pretreatment standard, or standard of performance; (3) any requirement established under this section; or (4) carrying out sections 305, 311, 402, and 504 of this Act—

"(A) the Administrator shall require the owner or operator of any point source to (i) establish and maintain such records, (ii) make such reports, (iii) install, use, and maintain such monitoring equipment or methods (including where appropriate, biological monitoring methods), (iv) sample such effluents (in accordance with such methods, at such locations, at such intervals, and in such manner as the Administrator shall prescribe), and (v) provide such other information as he may reasonably require; and

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"(B) the Administrator or his authorized representative, upon presentation of his credentials—

"(i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained under clause (A) of this subsection are located, and

"(ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required under clause (A), and sample any effluents which the owner or operator of such source is required to sample under such clause.

"(b) Any records, reports, or information obtained under this section (1) shall, in the case of effluent data, be related to any applicable effluent limitations, toxic, pretreatment, or new source performance standards, and (2) shall be available to the public, except that upon a showing satisfactory to the Administrator by any person that records, reports, or information, or particular part thereof (other than effluent data), to which the Administrator has access under this section, if made public would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such record, report, or information, or particular portion thereof confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such record, report, or information may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out this Act or when relevant in any proceeding under this Act.

"(c) Each State may develop and submit to the Administrator procedures under State law for inspection, monitoring, and entry with respect to point sources located in such State. If the Administrator finds that the procedures and the law of any State relating to inspection, monitoring, and entry are applicable to at least the same extent as those required by this section, such State is authorized to apply and enforce its procedures for inspection, monitoring, and entry with respect to point sources located in such State (except with respect to point sources owned or operated by the United States).

"FEDERAL ENFORCEMENT

"SEC. 309. (a)(1) Whenever, on the basis of any information available to him, the Administrator finds that any person is in violation of any condition or limitation which implements section 301, 302, 306, 307, or 308 of this Act in a permit issued by a State under an approved permit program under section 402 of this Act, he shall proceed under his authority in paragraph (3) of this subsection or he shall notify the person in alleged violation and such State of such finding. If beyond the thirtieth day after the Administrator's notification the State has not commenced appropriate enforcement action, the Administrator shall issue an order requiring such person to comply with such condition or limitation or shall bring a civil action in accordance with subsection (b) of this section.

"(2) Whenever, on the basis of information available to him, the Administrator finds that violations of permit conditions or limitations as set forth in paragraph (1) of this subsection are so widespread that such violations appear to result from a failure of the State to enforce such permit conditions or limitations effectively, he shall so notify the State. If the Administrator finds such failure extends beyond the thirtieth day after such notice, he shall give public notice of such finding. During the period beginning with such public notice and ending when such State satisfies the Administrator that it will enforce such conditions and limitations (hereafter referred to in this section as the period of 'federally assumed enforcement'), the Administrator shall enforce any permit condition or limitation with respect to any person—

"(A) by issuing an order to comply with such condition or limitation, or

"(B) by bringing a civil action under subsection (b) of this section.

"(3) Whenever on the basis of any information available to him the Administrator finds that any person is in violation of section 301, 302, 306, 307, or 308 of this Act, or is in violation of any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by him or by a State, he shall issue an order requiring such person to comply with such section or requirement, or he shall bring a civil action in accordance with subsection (b) of this section.

"(4) A copy of any order issued under this subsection shall be sent immediately by the Administrator to the State in which the violation occurs and other affected States. Any order issued under this subsection shall be by personal service and shall state with reasonable specificity the nature of the violation, specify a time for compliance, not to exceed thirty days, which the Administrator determines is reasonable, taking into account the seriousness of the violation and any good faith efforts to comply with applicable requirements. In any case in which an order under this subsection (or notice to a violator under paragraph (1) of this subsection) is issued to a corporation, a copy of such order (or notice) shall be served on any appropriate corporate officers. An order issued under this subsection relating to a violation of section 308 of this Act shall not take effect until the person to whom it is issued has had an opportunity to confer with the Administrator concerning the alleged violation.

"(b) The Administrator is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation for which he is authorized to issue a compliance order under subsection (a) of this section. Any action under this subsection may be brought in the district court of the United States for the district in which the defendant is located or resides or is doing business, and such court shall have jurisdiction to restrain such violation and to require compliance. Notice of the commencement of such action shall be given immediately to the appropriate State.

"(c)(1) Any person who willfully or negligently violates section 301, 302, 306, 307, or 308 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator or by a State, shall be punished by a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or by both. If the conviction is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $50,000 per day of violation, or by imprisonment for not more than two years, or by both.

"(2) Any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this Act or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this Act, shall upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both.

"(3) For the purposes of this subsection, the term 'person' shall mean, in addition to the definition contained in section 502(5) of this Act, any responsible corporate officer.

"(d) Any person who violates section 301, 302, 306, 307, or 308 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator, or by a State, and any person who violates any order issued by the Administrator under subsection (a) of this section, shall be subject to a civil penalty not to exceed $10,000 per day of such violation.

"(e) Whenever a municipality is a party to a civil action brought by the United States under this section, the State in which such municipality is located shall be joined as a party. Such State shall be liable for payment of any judgment, or any expenses incurred as a result of complying with any judgment, entered against the municipality in such action to the extent that the laws of that State prevent the municipality from raising revenues needed to comply with such judgment.

"INTERNATIONAL POLLUTION ABATEMENT

"SEC. 310. (a) Whenever the Administrator, upon receipts of reports, surveys, or studies from any duly constituted international agency, has reason to believe that pollution is occurring which endangers the health or welfare of persons in a foreign country, and the Secretary of State requests him to abate such pollution, he shall give formal notification thereof to the State water pollution control agency of the State or States in which such discharge or discharges originate and to the appropriate interstate agency, if any. He shall also promptly call such a hearing, if he believes that such pollution is occurring in sufficient quantity to warrant such action, and if such foreign country has given the United States essentially the same rights with respect to the prevention and control of pollution occurring in that country as is given that country by this subsection. The Administrator, through the Secretary of State, shall invite the foreign country which may be adversely affected by the pollution to attend and participate in the hearing, and the representative of such country shall, for the purpose of the hearing and any further proceeding resulting from such hearing, have all the rights of a State water pollution control agency. Nothing in this subsection shall be construed to modify, amend, repeal, or otherwise affect the provisions of the 1909 Boundary Waters Treaty between Canada and the United States or the Water Utilization Treaty of 1944 between Mexico and the United States (59 Stat. 1219), relative to the control and abatement of pollution in waters covered by those treaties.

"(b) The calling of a hearing under this section shall not be construed by the courts, the Administrator, or any person as limiting, modifying, or otherwise affecting the functions and responsibilities of the Administrator under this section to establish and enforce water quality requirements under this Act.

"(c) The Administrator shall publish in the Federal Register a notice of a public hearing before a hearing board of five or more persons appointed by the Administrator. A majority of the members of the board and the chairman who shall be designated by the Administrator shall not be officers or employees of Federal, State, or local governments. On the basis of the evidence presented at such hearing, the board shall within sixty days after completion of the hearing make findings of fact as to whether or not such pollution is occurring and shall thereupon by decision, incorporating its findings therein, make such recommendations to abate the pollution as

"(B) the Administrator or his authorized representative, upon presentation of his credentials—

"(i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained under clause (A) of this subsection are located, and

"(ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required under clause (A), and sample any effluents which the owner or operator of such source is required to sample under such clause.

"(b) Any records, reports, or information obtained under this section (1) shall, in the case of effluent data, be related to any applicable effluent limitations, toxic, pretreatment, or new source performance standards, and (2) shall be available to the public, except that upon a showing satisfactory to the Administrator by any person that records, reports, or information, or particular part thereof (other than effluent data), to which the Administrator has access under this section, if made public would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such record, report, or information, or particular portion thereof confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such record, report, or information may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out this Act or when relevant in any proceeding under this Act.

"(c) Each State may develop and submit to the Administrator procedures under State law for inspection, monitoring, and entry with respect to point sources located in such State. If the Administrator finds that the procedures and the law of any State relating to inspection, monitoring, and entry are applicable to at least the same extent as those required by this section, such State is authorized to apply and enforce its procedures for inspection, monitoring, and entry with respect to point sources located in such State (except with respect to point sources owned or operated by the United States).

"FEDERAL ENFORCEMENT

"SEC. 309. (a)(1) Whenever, on the basis of any information available to him, the Administrator finds that any person is in violation of any condition or limitation which implements section 301, 302, 306, 307, or 308 of this Act in a permit issued by a State under an approved permit program under section 402 of this Act, he shall proceed under his authority in paragraph (3) of this subsection or he shall notify the person in alleged violation and such State of such finding. If beyond the thirtieth day after the Administrator's notification the State has not commenced appropriate enforcement action, the Administrator shall issue an order requiring such person to comply with such condition or limitation or shall bring a civil action in accordance with subsection (b) of this section.

"(2) Whenever, on the basis of information available to him, the Administrator finds that violations of permit conditions or limitations as set forth in paragraph (1) of this subsection are so widespread that such violations appear to result from a failure of the State to enforce such permit conditions or limitations effectively, he shall so notify the State. If the Administrator finds such failure extends beyond the thirtieth day after such notice, he shall give public notice of such finding. During the period beginning with such public notice and ending when such State satisfies the Administrator that it will enforce such conditions and limitations (hereafter referred to in this section as the period of 'federally assumed enforcement'), the Administrator shall enforce any permit condition or limitation with respect to any person—

"(A) by issuing an order to comply with such condition or limitation, or

"(B) by bringing a civil action under subsection (b) of this section.

"(3) Whenever on the basis of any information available to him the Administrator finds that any person is in violation of section 301, 302, 306, 307, or 308 of this Act, or is in violation of any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by him or by a State, he shall issue an order requiring such person to comply with such section or requirement, or he shall bring a civil action in accordance with subsection (b) of this section.

"(4) A copy of any order issued under this subsection shall be sent immediately by the Administrator to the State in which the violation occurs and other affected States. Any order issued under this subsection shall be by personal service and shall state with reasonable specificity the nature of the violation, specify a time for compliance, not to exceed thirty days, which the Administrator determines is reasonable, taking into account the seriousness of the violation and any good faith efforts to comply with applicable requirements. In any case in which an order under this subsection (or notice to a violator under paragraph (1) of this subsection) is issued to a corporation, a copy of such order (or notice) shall be served on any appropriate corporate officers. An order issued under this subsection relating to a violation of section 308 of this Act shall not take effect until the person to whom it is issued has had an opportunity to confer with the Administrator concerning the alleged violation.

"(b) The Administrator is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation for which he is authorized to issue a compliance order under subsection (a) of this section. Any action under this subsection may be brought in the district court of the United States for the district in which the defendant is located or resides or is doing business, and such court shall have jurisdiction to restrain such violation and to require compliance. Notice of the commencement of such action shall be given immediately to the appropriate State.

"(c)(1) Any person who willfully or negligently violates section 301, 302, 306, 307, or 308 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator or by a State, shall be punished by a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or by both. If the conviction is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $50,000 per day of violation, or by imprisonment for not more than two years, or by both.

"(2) Any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this Act or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this Act, shall upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both.

"(3) For the purposes of this subsection, the term 'person' shall mean, in addition to the definition contained in section 502(5) of this Act, any responsible corporate officer.

"(d) Any person who violates section 301, 302, 306, 307, or 308 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator, or by a State, and any person who violates any order issued by the Administrator under subsection (a) of this section, shall be subject to a civil penalty not to exceed $10,000 per day of such violation.

"(e) Whenever a municipality is a party to a civil action brought by the United States under this section, the State in which such municipality is located shall be joined as a party. Such State shall be liable for payment of any judgment, or any expenses incurred as a result of complying with any judgment, entered against the municipality in such action to the extent that the laws of that State prevent the municipality from raising revenues needed to comply with such judgment.

"INTERNATIONAL POLLUTION ABATEMENT

"SEC. 310. (a) Whenever the Administrator, upon receipts of reports, surveys, or studies from any duly constituted international agency, has reason to believe that pollution is occurring which endangers the health or welfare of persons in a foreign country, and the Secretary of State requests him to abate such pollution, he shall give formal notification thereof to the State water pollution control agency of the State or States in which such discharge or discharges originate and to the appropriate interstate agency, if any. He shall also promptly call such a hearing, if he believes that such pollution is occurring in sufficient quantity to warrant such action, and if such foreign country has given the United States essentially the same rights with respect to the prevention and control of pollution occurring in that country as is given that country by this subsection. The Administrator, through the Secretary of State, shall invite the foreign country which may be adversely affected by the pollution to attend and participate in the hearing, and the representative of such country shall, for the purpose of the hearing and any further proceeding resulting from such hearing, have all the rights of a State water pollution control agency. Nothing in this subsection shall be construed to modify, amend, repeal, or otherwise affect the provisions of the 1909 Boundary Waters Treaty between Canada and the United States or the Water Utilization Treaty of 1944 between Mexico and the United States (59 Stat. 1219), relative to the control and abatement of pollution in waters covered by those treaties.

"(b) The calling of a hearing under this section shall not be construed by the courts, the Administrator, or any person as limiting, modifying, or otherwise affecting the functions and responsibilities of the Administrator under this section to establish and enforce water quality requirements under this Act.

"(c) The Administrator shall publish in the Federal Register a notice of a public hearing before a hearing board of five or more persons appointed by the Administrator. A majority of the members of the board and the chairman who shall be designated by the Administrator shall not be officers or employees of Federal, State, or local governments. On the basis of the evidence presented at such hearing, the board shall within sixty days after completion of the hearing make findings of fact as to whether or not such pollution is occurring and shall thereupon by decision, incorporating its findings therein, make such recommendations to abate the pollution as

may be appropriate and shall transmit such decision and the record of the hearings to the Administrator. All such decisions shall be public. Upon receipt of such decision, the Administrator shall promptly implement the board's decision in accordance with the provisions of this Act.

"(d) In connection with any hearing called under this subsection, the board is authorized to require any person whose alleged activities result in discharges causing or contributing to pollution to file with it in such forms as it may prescribe, a report based on existing data, furnishing such information as may reasonably be required as to the character, kind, and quantity of such discharges and the use of facilities or other means to prevent or reduce such discharges by the person filing such a report. Such report shall be made under oath or otherwise, as the board may prescribe, and shall be filed with the board within such reasonable period as it may prescribe, unless additional time is granted by it. Upon a showing satisfactory to the board by the person filing such report that such report or portion thereof (other than effluent data), to which the Administrator has access under this section, if made public would divulge trade secrets or secret processes of such person, the board shall consider such report or portion thereof confidential for the purposes of section 1905 of title 18 of the United States Code. If any person required to file any report under this paragraph shall fail to do so within the time fixed by the board for filing the same, and such failure shall continue for thirty days after notice of such default, such person shall forfeit to the United States the sum of $1,000 for each and every day of the continuance of such failure, which forfeiture shall be payable into the Treasury of the United States, and shall be recoverable in a civil suit in the name of the United States in the district court of the United States where such person has his principal office or in any district in which he does business. The Administrator may upon application therefor remit or mitigate any forfeiture provided for under this subsection.

"(e) Board members, other than officers or employees of Federal, State, or local governments, shall be for each day (including traveltime) during which they are performing board business, entitled to receive compensation at a rate fixed by the Administrator but not in excess of the maximum rate of pay for grade GS-18, as provided in the General Schedule under section 5332 of title 5 of the United States Code, and shall, notwithstanding the limitations of sections 5703 and 5704 of title 5 of the United States Code, be fully reimbursed for travel, subsistence, and related expenses.

"(f) When any such recommendation adopted by the Administrator involves the institution of enforcement proceedings against any person to obtain the abatement of pollution subject to such recommendation, the Administrator shall institute such proceedings if he believes that the evidence warrants such proceedings. The district court of the United States shall consider and determine de novo all relevant issues, but shall receive in evidence the record of the proceedings before the conference or hearing board. The court shall have jurisdiction to enter such judgment and orders enforcing such judgment as it deems appropriate or to remand such proceedings to the Administrator for such further action as it may direct.

"OIL AND HAZARDOUS SUBSTANCE LIABILITY

"SEC. 311. (a) For the purpose of this section, the term—

"(1) 'oil' means oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil;

"(2) 'discharge' includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping;

"(3) 'vessel' means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water other than a public vessel;

"(4) 'public vessel' means a vessel owned or bareboat-chartered and operated by the United States, or by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce;

"(5) 'United States' means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Canal Zone, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific Islands;

"(6) 'owner or operator' means (A) in the case of a vessel, any person owning, operating, or chartering by demise, such vessel, and (B) in the case of an onshore facility, and an offshore facility, any person owning or operating such onshore facility or offshore facility, and (C) in the case of any abandoned offshore facility, the person who owned or operated such facility immediately prior to such abandonment;

"(7) 'person' includes an individual, firm, corporation, association, and a partnership;

"(8) 'remove' or 'removal' refers to removal of the oil or hazardous substances from the water and shorelines or the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches;

"(9) 'contiguous zone' means the entire zone established or to be established by the United States under article 24 of the Convention on the Territorial Sea and the Contiguous Zone;

"(10) 'onshore facility' means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under, any land within the United States other than submerged land;

"(11) 'offshore facility' means any facility of any kind located in, on, or under, any of the navigable waters of the United States other than a vessel or a public vessel;

"(12) 'act of God' means an act occasioned by an unanticipated grave natural disaster;

"(13) 'barrel' means 42 United States gallons at 60 degrees Fahrenheit;

"(14) 'hazardous substance' means any substance designated pursuant to subsection (b)(2) of this section.

"(b)(1) The Congress hereby declares that it is the policy of the United States that there should be no discharges of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone.

"(2)(A) The Administrator shall develop, promulgate, and revise as may be appropriate, regulations designating as hazardous substances, other than oil as defined in this section, such elements and compounds which, when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone, present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches.

"(B)(i) The Administrator shall include in any designation under subparagraph (A) of this subsection a determination whether any such designated hazardous substance can actually be removed.

"(ii) The owner or operator of any vessel, onshore facility, or offshore facility from which there is discharged during the two-year period beginning on the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, any hazardous substance determined not removable under clause (i) of this subparagraph shall be liable, subject to the defenses to liability provided under subsection (f) of this section, as appropriate, to the United States for a civil penalty per discharge established by the Administrator based on toxicity, degradability, and dispersal characteristics of such substance, in an amount not to exceed $50,000, except that where the United States can show that such discharge was a result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States for a civil penalty in such amount as the Administrator shall establish, based upon the toxicity, degradability, and dispersal characteristics of such substance.

"(iii) After the expiration of the two-year period referred to in clause (ii) of this subparagraph, the owner or operator of any vessel, onshore facility, or offshore facility, from which there is discharged any hazardous substance determined not removable under clause (i) of this subparagraph shall be liable, subject to the defenses to liability provided in subsection (f) of this section, to the United States for either one or the other of the following penalties, the determination of which shall be in the discretion of the Administrator:

"(aa) a penalty in such amount as the Administrator shall establish, based on the toxicity, degradability, and dispersal characteristics of the substance, but not less than $500 nor more than $5,000; or

"(bb) a penalty determined by the number of units discharged multiplied by the amount established for such unit under clause (iv) of this subparagraph, but such penalty shall not be more than $5,000,000 in the case of a discharge from a vessel and $500,000 in the case of a discharge from an onshore or offshore facility.

"(iv) The Administrator shall establish by regulation, for each hazardous substance designated under subparagraph (A) of this paragraph, and within 180 days of the date of such designation, a unit of measurement based upon the usual trade practice and, for the purpose of determining the penalty under clause (iii)(bb) of this subparagraph, shall establish for each such unit a fixed monetary amount which shall be not less than $100 nor more than $1,000 per unit. He shall establish such fixed amount based on the toxicity, degradability, and dispersal characteristics of the substance.

"(3) The discharge of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone in harmful quantities as determined by the President under paragraph (4) of this subsection, is prohibited, except (A) in the case of such discharges of oil into the waters of the contiguous zone, where permitted under article IV of the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended, and (B) where permitted in quantities and at times and locations or under such circumstances or conditions as the President may, by regulation, determine not to be harmful. Any regulations issued under this subsection shall be consistent with maritime safety and with marine and navigation laws and regulations and applicable water quality standards.

"(4) The President shall by regulation, to be issued as soon as possi-

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ble after the date of enactment of this paragraph, determine for the purposes of this section, those quantities of oil and any hazardous substance the discharge of which, at such times, locations, circumstances, and conditions, will be harmful to the public health or welfare of the United States, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches except that in the case of the discharge of oil into or upon the waters of the contiguous zone, only those discharges which threaten the fishery resources of the contiguous zone or threaten to pollute or contribute to the pollution of the territory or the territorial sea of the United States may be determined to be harmful.

"(5) Any person in charge of a vessel or of an onshore facility or an offshore facility shall, as soon as he has knowledge of any discharge of oil or a hazardous substance from such vessel or facility in violation of paragraph (3) of this subsection, immediately notify the appropriate agency of the United States Government of such discharge. Any such person who fails to notify immediately such agency of such discharge shall, upon conviction, be fined not more than $10,000, or imprisoned for not more than one year, or both. Notification received pursuant to this paragraph or information obtained by the exploitation of such notification shall not be used against any such person in any criminal case, except a prosecution for perjury or for giving a false statement.

"(6) Any owner or operator of any vessel, onshore facility, or offshore facility from which oil or a hazardous substance is discharged in violation of paragraph (3) of this subsection shall be assessed a civil penalty by the Secretary of the department in which the Coast Guard is operating of not more than $5,000 for each offense. No penalty shall be assessed unless the owner or operator charged shall have been given notice and opportunity for a hearing on such charge. Each violation is a separate offense. Any such civil penalty may be compromised by such Secretary. In determining the amount of the penalty, or the amount agreed upon in compromise, the appropriateness of such penalty to the size of the business of the owner or operator charged, the effect on the owner or operator's ability to continue in business, and the gravity of the violation, shall be considered by such Secretary. The Secretary of the Treasury shall withhold at the request of such Secretary the clearance required by section 4197 of the Revised Statutes of the United States, as amended (46 U.S.C. 91), of any vessel the owner or operator of which is subject to the foregoing penalty. Clearance may be granted in such cases upon the filing of a bond or other surety satisfactory to such Secretary.

"(c)(1) Whenever any oil or a hazardous substance is discharged, into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone, the President is authorized to act to remove or arrange for the removal of such oil or substance at any time, unless he determines such removal will be done properly by the owner or operator of the vessel, onshore facility, or offshore facility from which the discharge occurs.

"(2) Within sixty days after the effective date of this section, the President shall prepare and publish a National Contingency Plan for removal of oil and hazardous substances, pursuant to this subsection. Such National Contingency Plan shall provide for efficient, coordinated, and effective action to minimize damage from oil and hazardous substance discharges, including containment, dispersal, and removal of oil and hazardous substances, and shall include, but not be limited to—

"(A) assignment of duties and responsibilities among Federal departments and agencies in coordination with State and local agencies, including, but not limited to, water pollution control, conservation, and port authorities;

"(B) identification, procurement, maintenance, and storage of equipment and supplies;

"(C) establishment or designation of a strike force consisting of personnel who shall be trained, prepared, and available to provide necessary services to carry out the Plan, including the establishment at major ports, to be determined by the President, of emergency task forces of trained personnel, adequate oil and hazardous substance pollution control equipment and material, and a detailed oil and hazardous substance pollution prevention and removal plan;

"(D) a system of surveillance and notice designed to insure earliest possible notice of discharges of oil and hazardous substances to the appropriate Federal agency;

"(E) establishment of a national center to provide coordination and direction for operations in carrying out the Plan;

"(F) procedures and techniques to be employed in identifying, containing, dispersing, and removing oil and hazardous substances;

"(G) a schedule, prepared in cooperation with the States, identifying (i) dispersants and other chemicals, if any, that may be used in carrying out the Plan, (ii) the waters in which such dispersants and chemicals may be used, and (iii) the quantities of such dispersant or chemical which can be used safely in such waters, which schedule shall provide in the case of any dispersant, chemical, or waters not specifically identified in such schedule that the President, or his delegate, may, on a case-by-case basis, identify the dispersants and other chemicals which may be used, the waters in which they may be used, and the quantities which can be used safely in such waters; and

"(H) a system whereby the State or States affected by a discharge of oil or hazardous substance may act where necessary to remove such discharge and such State or States may be reimbursed from the fund established under subsection (k) of this section for the reasonable costs incurred in such removal.

The President may, from time to time, as he deems advisable revise or otherwise amend the National Contingency Plan. After publication of the National Contingency Plan, the removal of oil and hazardous substances and actions to minimize damage from oil and hazardous substance discharges shall, to the greatest extent possible, be in accordance with the National Contingency Plan.

"(d) Whenever a marine disaster in or upon the navigable waters of the United States has created a substantial threat of a pollution hazard to the public health or welfare of the United States, including, but not limited to, fish, shellfish, and wildlife and the public and private shorelines and beaches of the United States, because of a discharge, or an imminent discharge, of large quantities of oil, or of a hazardous substance from a vessel the United States may (A) coordinate and direct all public and private efforts directed at the removal or elimination of such threat; and (B) summarily remove, and, if necessary, destroy such vessel by whatever means are available without regard to any provisions of law governing the employment of personnel or the expenditure of appropriated funds. Any expense incurred under this subsection shall be a cost incurred by the United States Government for the purposes of subsection (f) in the removal of oil or hazardous substance.

"(e) In addition to any other action taken by a State or local government, when the President determines there is an imminent and substantial threat to the public health or welfare of the United States, including, but not limited to, fish, shellfish, and wildlife and public and private property, shorelines, and beaches within the United States, because of an actual or threatened discharge of oil or hazardous substance into or upon the navigable waters of the United States from an onshore or offshore facility, the President may require the United States attorney of the district in which the threat occurs to secure such relief as may be necessary to abate such threat, and the district courts of the United States shall have jurisdiction to grant such relief as the public interest and the equities of the case may require.

"(f)(1) Except where an owner or operator can prove that a discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent, or any combination of the foregoing clauses, such owner or operator of any vessel from which oil or a hazardous substance is discharged in violation of subsection (b) (3) of this section shall, not withstanding any other provision of law, be liable to the United States Government for the actual costs incurred under subsection (c) for the removal of such oil or substance by the United States Government in an amount not to exceed $100 per gross ton of such vessel or $14,000,000, whichever is lesser, except that where the United States can show that such discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States Government for the full amount of such costs. Such costs shall constitute a maritime lien on such vessel which may be recovered in an action in rem in the district court of the United States for any district within which any vessel may be found. The United States may also bring an action against the owner or operator of such vessel in any court of competent jurisdiction to recover such costs.

"(2) Except where an owner or operator of an onshore facility can prove that a discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent, or any combination of the foregoing clauses, such owner or operator of any such facility from which oil or a hazardous substance is discharged in violation of subsection (b) (3) of this section shall be liable to the United States Government for the actual costs incurred under subsection (c) for the removal of such oil or substance by the United States Government in an amount not to exceed $8,000,000, except that where the United States can show that such discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States Government for the full amount of such costs. The United States may bring an action against the owner or operator of such facility in any court of competent jurisdiction to recover such costs. The Administrator is authorized, by regulation, after consultation with the Secretary of Commerce and the Small Business Administration, to establish reasonable and equitable classifications of those onshore facilities having a total fixed storage capacity of 1,000 barrels or less which he determines because of size, type, and location do not present a substantial risk of the discharge of oil or a hazardous substance in violation of subsection (b) (3) of this section, and apply with respect to such classifica-

tions differing limits of liability which may be less than the amount contained in this paragraph.

"(3) Except where an owner or operator of an offshore facility can prove that a discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent, or any combination of the foregoing clauses, such owner or operator of any such facility from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section shall, notwithstanding any other provision of law, be liable to the United States Government for the actual costs incurred under subsection (c) for the removal of such oil or substance by the United States Government in an amount not to exceed $8,000,000, except that where the United States can show that such discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States Government for the full amount of such costs. The United States may bring an action against the owner or operator of such a facility in any court of competent jurisdiction to recover such costs.

"(g) In any case where an owner or operator of a vessel, of an onshore facility, or of an offshore facility, from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section, proves that such discharge of oil or hazardous substance was caused solely by an act or omission of a third party, or was caused solely by such an act or omission in combination with an act of God, an act of war, or negligence on the part of the United States Government, such third party shall, notwithstanding any other provision of law, be liable to the United States Government for the actual costs incurred under subsection (c) for removal of such oil or substance by the United States Government, except where such third party can prove that such discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of another party without regard to whether such act or omission was or was not negligent, or any combination of the foregoing clauses. If such third party was the owner or operator of a vessel which caused the discharge of oil or a hazardous substance in violation of subsection (b)(3) of this section, the liability of such third party under this subsection shall not exceed $100 per gross ton of such vessel or $14,000,000, whichever is the lesser. In any other case the liability of such third party shall not exceed the limitation which would have been applicable to the owner or operator of the vessel or the onshore or offshore facility from which the discharge actually occurred if such owner or operator were liable. If the United States can show that the discharge of oil or a hazardous substance in violation of subsection (b)(3) of this section was the result of willful negligence or willful misconduct within the privity and knowledge of such third party, such third party shall be liable to the United States Government for the full amount of such removal costs. The United States may bring an action against the third party in any court of competent jurisdiction to recover such removal costs.

"(h) The liabilities established by this section shall in no way affect any rights which (1) the owner or operator of a vessel or of an onshore facility or an offshore facility may have against any third party whose acts may in any way have caused or contributed to such discharge, or (2) The United States Government may have against any third party whose actions may in any way have caused or contributed to the discharge of oil or hazardous substance.

"(i)(1) In any case where an owner or operator of a vessel or an onshore facility or an offshore facility from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section acts to remove such oil or substance in accordance with regulations promulgated pursuant to this section, such owner or operator shall be entitled to recover the reasonable costs incurred in such removal upon establishing, in a suit which may be brought against the United States Government in the United States Court of Claims, that such discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether such act or omission was or was not negligent, or of any combination of the foregoing causes.

"(2) The provisions of this subsection shall not apply in any case where liability is established pursuant to the Outer Continental Shelf Lands Act.

"(3) Any amount paid in accordance with a judgment of the United States Court of Claims pursuant to this section shall be paid from the funds established pursuant to subsection (k).

"(j)(1) Consistent with the National Contingency Plan required by subsection (c)(2) of this section, as soon as practicable after the effective date of this section, and from time to time thereafter, the President shall issue regulations consistent with maritime safety and with marine and navigation laws (A) establishing methods and procedures for removal of discharged oil and hazardous substances, (B) establishing criteria for the development and implementation of local and regional oil and hazardous substance removal contingency plans, (C) establishing procedures, methods, and equipment and other requirements for equipment to prevent discharges of oil and hazardous substances from vessels and from onshore facilities and offshore facilities, and to contain such discharges, and (D) governing the inspection of vessels carrying cargoes of oil and hazardous substances and the inspection of such cargoes in order to reduce the likelihood of discharges of oil from vessels in violation of this section.

"(2) Any owner or operator of a vessel or an onshore facility or an offshore facility and any other person subject to any regulation issued under paragraph (1) of this subsection who fails or refuses to comply with the provisions of any such regulations, shall be liable to a civil penalty of not more than $5,000 for each such violation. Each violation shall be a separate offense. The President may assess and compromise such penalty. No penalty shall be assessed until the owner, operator, or other person charged shall have been given notice and an opportunity for a hearing on such charge. In determining the amount of the penalty, or the amount agreed upon in compromise, the gravity of the violation, and the demonstrated good faith of the owner, operator, or other person charged in attemping to achieve rapid compliance, after notification of a violation, shall be considered by the President.

"(k) There is hereby authorized to be appropriated to a revolving fund to be established in the Treasury not to exceed $35,000,000 to carry out the provisions of subsections (c), (d), (i), and (l) of this section. Any other funds received by the United States under this section shall also be deposited in said fund for such purposes. All sums appropriated to, or deposited in, said fund shall remain available until expended.

"(l) The President is authorized to delegate the administration of this section to the heads of those Federal departments, agencies, and instrumentalities which he determines to be appropriate. Any moneys in the fund established by subsection (k) of this section shall be available to such Federal departments, agencies, and instrumentalities to carry out the provisions of subsections (c) and (i) of this section. Each such department, agency, and instrumentality, in order to avoid duplication of effort, shall, whenever appropriate, utilize the personnel, services, and facilities of other Federal departments, agencies, and instrumentalities.

"(m) Anyone authorized by the President to enforce the provisions of this section may, except as to public vessels, (A) board and inspect any vessel upon the navigable waters of the United States or the waters of the contiguous zone, (B) with or without a warrant arrest any person who violates the provisions of this section or any regulation issued thereunder in his presence or view, and (C) execute any warrant or other process issued by an officer or court of competent jurisdiction.

"(n) The several district courts of the United States are invested with jurisdiction for any actions, other than actions pursuant to subsection (i)(1), arising under this section. In the case of Guam and the Trust Territory of the Pacific Islands, such actions may be brought in the district court of Guam, and in the case of the Virgin Islands such actions may be brought in the district court of the Virgin Islands. In the case of American Samoa and the Trust Territory of the Pacific Islands, such actions may be brought in the District Court of the United States for the District of Hawaii and such court shall have jurisdiction of such actions. In the case of the Canal Zone, such actions may be brought in the United States District Court for the District of the Canal Zone.

"(o)(1) Nothing in this section shall affect or modify in any way the obligations of any owner or operator of any vessel, or of any owner or operator of any onshore facility or offshore facility to any person or agency under any provision of law for damages to any publicly owned or privately owned property resulting from a discharge of any oil or hazardous substance or from the removal of any such oil or hazardous substance.

"(2) Nothing in this section shall be construed as preempting any State or political subdivision thereof from imposing any requirement or liability with respect to the discharge of oil or hazardous substance into any waters within such State.

"(3) Nothing in this section shall be construed as affecting or modifying any other existing authority of any Federal department, agency, or instrumentality, relative to onshore or offshore facilities under this Act or any other provision of law, or to affect any State or local law not in conflict with this section.

"(p)(1) Any vessel over three hundred gross tons, including any barge of equivalent size, but not including any barge that is not self-propelled and that does not carry oil or hazardous substances as cargo or fuel, using any port or place in the United States or the navigable waters of the United States for any purpose shall establish and maintain under regulations to be prescribed from time to time by the President, evidence of financial responsibility of $100 per gross ton, or $14,000,000 whichever is the lesser, to meet the liability to the United States which such vessel could be subjected under this section. In cases where an owner or operator owns, operates, or charters more than one such vessel, financial responsibility need only be established to meet the maximum liability to which the largest of such vessels could be subjected. Financial responsibility may be established by any one of, or a combination of, the following methods acceptable to the Presi-

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dent: (A) evidence of insurance, (B) surety bonds, (C) qualification as a self-insurer, or (D) other evidence of financial responsibility. Any bond filed shall be issued by a bonding company authorized to do business in the United States.

"(2) The provisions of paragraph (1) of this subsection shall be effective April 3, 1971, with respect to oil and one year after the date of enactment of this section with respect to hazardous substances. The President shall delegate the responsibility to carry out the provisions of this subsection to the appropriate agency head within sixty days after the date of enactment of this section. Regulations necessary to implement this subsection shall be issued within six months after the date of enactment of this section.

"(3) Any claim for costs incurred by such vessel may be brought directly against the insurer or any other person providing evidence of financial responsibility as required under this subsection. In the case of any action pursuant to this subsection such insurer or other person shall be entitled to invoke all rights and defenses which would have been available to the owner or operator if an action had been brought against him by the claimant, and which would have been available to him if an action had been brought against him by the owner or operator.

"(4) Any owner or operator of a vessel subject to this subsection, who fails to comply with the provisions of this subsection or any regulation issued thereunder, shall be subject to a fine of not more than $10,000.

"(5) The Secretary of the Treasury may refuse the clearance required by section 4197 of the Revised Statutes of the United States, as amended (4 U.S.C. 91), to any vessel subject to this subsection, which does not have evidence furnished by the President that the financial responsibility provisions of paragraph (1) of this subsection have been complied with.

"(6) The Secretary of the Department in which the Coast Guard is operated may (A) deny entry to any port or place in the United States or the navigable waters of the United States, to, and (B) detain at the port or place in the United States from which it is about to depart for any other port or place in the United States, any vessel subject to this subsection, which upon request, does not produce evidence furnished by the President that the financial responsibility provisions of paragraph (1) of this subsection have been complied with.

"MARINE SANITATION DEVICES

"SEC. 312. (a) For the purpose of this section, the term—

"(1) 'new vessel' includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the navigable waters, the construction of which is initiated after promulgation of standards and regulations under this section;

"(2) 'existing vessel' includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the navigable waters, the construction of which is initiated before promulgation of standards and regulations under this section;

"(3) 'public vessel' means a vessel owned or bareboat chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce;

"(4) 'United States' includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands;

"(5) 'marine sanitation device' includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage;

"(6) 'sewage' means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes;

"(7) 'manufacturer' means any person engaged in the manufacturing, assembling, or importation of marine sanitation devices or of vessels subject to standards and regulations promulgated under this section;

"(8) 'person' means an individual, partnership, firm, corporation, or association, but does not include an individual on board a public vessel;

"(9) 'discharge' includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping.

"(b)(1) As soon as possible, after the enactment of this section and subject to the provisions of section 101(j) of this Act, the Administrator, after consultation with the Secretary of the department in which the Coast Guard is operating, after giving appropriate consideration to the economic costs involved, and within the limits of available technology, shall promulgate Federal standards of performance for marine sanitation devices (hereafter in this section referred to as 'standards') which shall be designed to prevent the discharge of untreated or inadequately treated sewage into or upon the navigable waters from new vessels and existing vessels, except vessels not equipped with installed toilet facilities. Such standards shall be consistent with maritime safety and the marine and navigation laws and regulations and shall be coordinated with the regulations issued under this subsection by the Secretary of the department in which the Coast Guard is operating. The Secretary of the department in which the Coast Guard is operating shall promulgate regulations, which are consistent with standards promulgated under this subsection and with maritime safety and the marine and navigation laws and regulations governing the design, construction, installation, and operation of any marine sanitation device on board such vessels.

"(2) Any existing vessel equipped with a marine sanitation device on the date of promulgation of initial standards and regulations under this section, which device is in compliance with such initial standards and regulations, shall be deemed in compliance with this section until such time as the device is replaced or is found not to be in compliance with such initial standards and regulations.

"(c)(1) Initial standards and regulations under this section shall become effective for new vessels two years after promulgation; and for existing vessels five years after promulgation. Revisions of standards and regulations shall be effective upon promulgation, unless another effective date is specified, except that no revision shall take effect before the effective date of the standard or regulation being revised.

"(2) The Secretary of the department in which the Coast Guard is operating with regard to his regulatory authority established by this section, after consultation with the Administrator, may distinguish among classes, type, and sizes of vessels as well as between new and existing vessels, and may waive applicability of standards and regulations as necessary or appropriate for such classes, types, and sizes of vessels (including existing vessels equipped with marine sanitation devices on the date of promulgation of the initial standards required by this section), and, upon application, for individual vessels.

"(d) The provisions of this section and the standards and regulations promulgated hereunder apply to vessels owned and operated by the United States unless the Secretary of Defense finds that compliance would not be in the interest of national security. With respect to vessels owned and operated by the Department of Defense, regulations under the last sentence of subsection (b)(1) of this section and certifications under subsection (g)(2) of this section shall be promulgated and issued by the Secretary of Defense.

"(e) Before the standards and regulations under this section are promulgated, the Administrator and the Secretary of the department in which the Coast Guard is operating shall consult with the Secretary of State; the Secretary of Health, Education, and Welfare; the Secretary of Defense; the Secretary of the Treasury; the Secretary of Commerce; other interested Federal agencies; and the States and industries interested; and otherwise comply with the requirements of section 553 of title 5 of the United States Code.

"(f)(1) After the effective date of the initial standards and regulations promulgated under this section, no State or political subdivision thereof shall adopt or enforce any statute or regulation of such State or political subdivision with respect to the design, manufacture, or installation or use of any marine sanitation device on any vessel subject to the provisions of this section.

"(2) If, after promulgation of the initial standards and regulations and prior to their effective date, a vessel is equipped with a marine sanitation device in compliance with such standards and regulations and the installation and operation of such device is in accordance with such standards and regulations, such standards and regulations shall, for the purposes of paragraph (1) of this subsection, become effective with respect to such vessel on the date of such compliance.

"(3) After the effective date of the initial standards and regulations promulgated under this section, if any State determines that the protection and enhancement of the quality of some or all of the waters within such State require greater environmental protection, such State may completely prohibit the discharge from all vessels of any sewage, whether treated or not, into such waters, except that no such prohibition shall apply until the Administrator determines that adequate facilities for the safe and sanitary removal and treatment of sewage from all vessels are reasonably available for such water to which such prohibition would apply. Upon application of the State, the Administrator shall make such determination within 90 days of the date of such application.

"(4) If the Administrator determines upon application by a State that the protection and enhancement of the quality of specified waters within such State requires such a prohibition, he shall by regulation completely prohibit the discharge from a vessel of any sewage (whether treated or not) into such waters.

"(g)(1) No manufacturer of a marine sanitation device shall sell, offer for sale, or introduce or deliver for introduction in interstate commerce, or import into the United States for sale or resale any marine sanitation device manufactured after the effective date of the standards and regulations promulgated under this section unless such device is in all material respects substantially the same as a test device certified under this subsection.

"(2) Upon application of the manufacturer, the Secretary of the

department in which the Coast Guard is operating shall so certify a marine sanitation device if he determines, in accordance with the provisions of this paragraph, that it meets the appropriate standards and regulations promulgated under this section. The Secretary of the department in which the Coast Guard is operating shall test or require such testing of the device in accordance with procedures set forth by the Administrator as to standards of performance and for such other purposes as may be appropriate. If the Secretary of the department in which the Coast Guard is operating determines that the device is satisfactory from the standpoint of safety and any other requirements of maritime law or regulation, and after consideration of the design, installation, operation, material, or other appropriate factors, he shall certify the device. Any device manufactured by such manufacturer which is in all material respects substantially the same as the certified test device shall be deemed to be in conformity with the appropriate standards and regulations established under this section.

"(3) Every manufacturer shall establish and maintain such records, make such reports, and provide such information as the Administrator or the Secretary of the department in which the Coast Guard is operating may reasonably require to enable him to determine whether such manufacturer has acted or is acting in compliance with this section and regulations issued thereunder and shall, upon request of an officer or employee duly designated by the Administrator or the Secretary of the department in which the Coast Guard is operating, permit such officer or employee at reasonable times to have access to and copy such records. All information reported to or otherwise obtained by the Administrator or the Secretary of the department in which the Coast Guard is operating or their representatives pursuant to this subsection which contains or relates to a trade secret or other matter referred to in section 1905 of title 18 of the United States Code shall be considered confidential for the purpose of that section, except that such information may be disclosed to other officers or employees concerned with carrying out this section. This paragraph shall not apply in the case of the construction of a vessel by an individual for his own use.

"(h) After the effective date of standards and regulations promulgated under this section, it shall be unlawful—

"(1) for the manufacturer of any vessel subject to such standards and regulations to manufacture for sale, to sell or offer for sale, or to distribute for sale or resale any such vessel unless it is equipped with a marine sanitation device which is in all material respects substantially the same as the appropriate test device certified pursuant to this section;

"(2) for any person, prior to the sale or delivery of a vessel subject to such standards and regulations to the ultimate purchaser, wrongfully to remove or render inoperative any certified marine sanitation device or element of design of such device installed in such vessel;

"(3) for any person to fail or refuse to permit access to or copying of records or to fail to make reports or provide information required under this section; and

"(4) for a vessel subject to such standards and regulations to operate on the navigable waters of the United States, if such vessel is not equipped with an operable marine sanitation device certified pursuant to this section.

"(i) The district courts of the United States shall have jurisdictions to restrain violations of subsection (g)(1) of this section and subsections (h)(1) through (3) of this section. Actions to restrain such violations shall be brought by, and in, the name of the United States. In case of contumacy or refusal to obey a subpena served upon any person under this subsection, the district court of the United States for any district in which such person is found or resides or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony or to appear and produce documents, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

"(j) Any person who violates subsection (g)(1) of this section or clause (1) or (2) of subsection (h) of this section shall be liable to a civil penalty of not more than $5,000 for each violation. Any person who violates clause (4) of subsection (h) of this section or any regulation issued pursuant to this section shall be liable to a civil penalty of not more than $2,000 for each violation. Each violation shall be a separate offense. The Secretary of the department in which the Coast Guard is operating may assess and compromise any such penalty. No penalty shall be assessed until the person charged shall have been given notice and an opportunity for a hearing on such charge. In determining the amount of the penalty, or the amount agreed upon in compromise, the gravity of the violation, and the demonstrated good faith of the person charged in attempting to achieve rapid compliance, after notification of a violation, shall be considered by said Secretary.

"(k) The provisions of this section shall be enforced by the Secretary of the department in which the Coast Guard is operating and he may utilize by agreement, with or without reimbursement, law enforcement officers or other personnel and facilities of the Administrator, other Federal agencies, or the States to carry out the provisions of this section.

"(l) Anyone authorized by the Secretary of the department in which the Coast Guard is operating to enforce the provisions of this section may, except as to public vessels, (1) board and inspect any vessel upon the navigable waters of the United States and (2) execute any warrant or other process issued by an officer or court of competent jurisdiction.

"(m) In the case of Guam and the Trust Territory of the Pacific Islands, actions arising under this section may be brought in the district court of Guam, and in the case of the Virgin Islands such actions may be brought in the district court of the Virgin Islands. In the case of American Samoa and the Trust Territory of the Pacific Islands, such actions may be brought in the District Court of the United States for the District of Hawaii and such court shall have jurisdiction of such actions. In the case of the Canal Zone, such actions may be brought in the District Court for the District of the Canal Zone.

"FEDERAL FACILITIES POLLUTION CONTROL

"SEC. 313. Each department, agency, or instrumentality of the executive, legislative, and judicial branches of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants shall comply with Federal, State, interstate, and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements, including the payment of reasonable service charges. The President may exempt any effluent source of any department, agency, or instrumentality in the executive branch from compliance with any such a requirement if he determines it to be in the paramount interest of the United States to do so; except that no exemption may be granted from the requirements of section 306 or 307 of this Act. No such exemptions shall be granted due to lack of appropriation unless the President shall have specifically requested such appropriation as a part of the budgetary process and the Congress shall have failed to make available such requested appropriation. Any exemption shall be for a period not in excess of one year, but additional exemptions may be granted for periods of not to exceed one year upon the President's making a new determination. The President shall report each January to the Congress all exemptions from the requirements of this section granted during the preceding calendar year, together with his reason for granting such exemption.

"CLEAN LAKES

"SEC. 314. (a) Each State shall prepare or establish, and submit to the Administrator for his approval—

"(1) an identification and classification according to eutrophic condition of all publicly owned fresh water lakes in such State;

"(2) procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes; and

"(3) methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes.

"(b) The Administrator shall provide financial assistance to States in order to carry out methods and procedures approved by him under this section.

"(c)(1) The amount granted to any State for any fiscal year under this section shall not exceed 70 per centum of the funds expended by such State in such year for carrying out approved methods and procedures under this section.

"(2) There is authorized to be appropriated $50,000,000 for the fiscal year ending June 30, 1973; $100,000,000 for the fiscal year 1974; and $150,000,000 for the fiscal year 1975 for grants to States under this section which such sums shall remain available until expended. The Administrator shall provide for an equitable distribution of such sums to the States with approved methods and procedures under this section.

"NATIONAL STUDY COMMISSION

"SEC. 315. (a) There is established a National Study Commission, which shall make a full and complete investigation and study of all of the technological aspects of achieving, and all aspects of the total economic, social, and environmental effects of achieving or not achieving, the effluent limitations and goals set forth for 1983 in section 301(b)(2) of this Act.

"(b) Such Commission shall be composed of fifteen members, including five members of the Senate, who are members of the Public Works committee, appointed by the President of the Senate, five members of the House, who are members of the Public Works committee, appointed by the Speaker of the House, and five members of the public appointed by the President. The Chairman of such Commission shall be elected from among its members.

"(c) In the conduct of such study, the Commission is authorized to contract with the National Academy of Sciences and the National Academy of Engineering (acting through the National Research Council), the National Institute of Ecology, Brookings Institution, and other nongovernmental entities, for the investigation of matters within their competence.

"(d) The heads of the departments, agencies and instrumentalities of the executive branch of the Federal Government shall cooperate

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with the Commission in carrying out the requirements of this section, and shall furnish to the Commission such information as the Commission deems necessary to carry out this section.

(e) A report shall be submitted to the Congress of the results of the investigation and study, together with recommendations, not later than three years after the date of enactment of this title.

"(f) The members of the Commission who are not officers or employees of the United States, while attending conferences or meetings of the Commission or while otherwise serving at the request of the Chairman shall be entitled to receive compensation at a rate not in excess of the maximum rate of pay for grade GS-18, as provided in the General Schedule under section 5332 of title V of the United States Code, including traveltime and while away from their homes or regular places of business they may be allowed travel expenses, including per diem in lieu of subsistence as authorized by law (5 U.S.C. 73b-2) for persons in the Government service employed intermittently.

"(g) In addition to authority to appoint personnel subject to the provisions of title 5, United States Code, governing appointments in the competitive service, and to pay such personnel in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates, the Commission shall have authority to enter into contracts with private or public organization who shall furnish the Commission with such administrative and technical personnel as may be necessary to carry out the purpose of this section. Personnel furnished by such organizations under this subsection are not, and shall not be considered to be, Federal employees for any purposes, but in the performance of their duties shall be guided by the standards which apply to employees of the legislative branches under rules 41 and 43 of the Senate and House of Representatives, respectively."; and

(h) There is authorized to be appropriated, for use in carrying out this section, not to exceed $17,250,000.

"THERMAL DISCHARGES

"SEC. 316. (a) With respect to any point source otherwise subject to the provisions of section 301 or section 306 of this Act, whenever the owner or operator of any such source, after opportunity for public hearing, can demonstrate to the satisfaction of the Administrator (or, if appropriate, the State) that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the projection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made, the Administrator (or, if appropriate, the State) may impose an effluent limitation under such sections for such plant, with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water.

"(b) Any standard established pursuant to section 301 or section 306 of this Act and applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.

"(c) Notwithstanding any other provision of this Act, any point source of a discharge having a thermal component, the modification of which point source is commenced after the date of enactment of the Federal Water Poilution Control Act Amendments of 1972 and which, as modified, meets effluent limitations established under section 301 or, if more stringent, effluent limitations established under section 303 and which effluent limitations will assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in or on the water into which the discharge is made, shall not be subject to any more stringent effluent limitation with respect to the thermal component of its discharge during a ten year period beginning on the date of completion of such modification or during the period of depreciation or amortization of such facility for the purpose of section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first.

"FINANCING STUDY

"SEC. 317. (a) The Administrator shall continue to investigate and study the feasibility of alternate methods of financing the cost of preventing, controlling and abating pollution as directed in the Water Quality Improvement Act of 1970 (Public Law 91-224), including, but not limited to, the feasibility of establishing a pollution abatement trust fund. The results of such investigation and study shall be reported to the Congress not later than two years after enactment of this title, together with recommendations of the Administrator for financing the programs for preventing, controlling and abating pollution for the fiscal years beginning after fiscal year 1976, including any necessary legislation.

"(b) There is authorized to be appropriated for use in carrying out this section, not to exceed $1,000,000.

"AQUACULTURE

"SEC. 318. (a) The Administrator is authorized, after public hearings, to permit the discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project under Federal or State supervision.

"(b) The Administrator shall by regulation, not later than January 1, 1974, establish any procedures and guidelines he deems necessary to carry out this section.

"TITLE IV—PERMITS AND LICENSES

"CERTIFICATION

"SEC. 401. (a)(1) Any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over the navigable waters at the point where the discharge originates or will originate, that any such discharge will comply with the applicable provisions of sections 301, 302, 306, and 307 of this Act. In the case of any such activity for which there is not an applicable effluent limitation or other limitation under sections 301(b) and 302, and there is not an applicable standard under sections 306 and 307, the State shall so certify, except that any such certification shall not be deemed to satisfy section 511(c) of this Act. Such State or interstate agency shall establish procedures for public notice in the case of all applications for certification by it and, to the extent it deems appropriate, procedures for public hearings in connection with specific applications. In any case where a State or interstate agency has no authority to give such a certification, such certification shall be from the Administrator. If the State, interstate agency, or Administrator, as the case may be, fails or refuses to act on a request for certification, within a reasonable period of time (which shall not exceed one year) after receipt of such request, the certification requirements of this subsection shall be waived with respect to such Federal application. No license or permit shall be granted until the certification required by this section has been obtained or has been waived as provided in the preceding sentence. No license or permit shall be granted if certification has been denied by the State, interstate agency, or the Administrator, as the case may be.

"(2) Upon receipt of such application and certification the licensing or permitting agency shall immediately notify the Administrator of such application and certification. Whenever such a discharge may affect, as determined by the Administrator, the quality of the waters of any other State, the Administrator within thirty days of the date of notice of application for such Federal license or permit shall so notify such other State, the licensing or permitting agency, and the applicant. If, within sixty days after receipt of such notification, such other State determines that such discharge will affect the quality of its waters so as to violate any water quality requirement in such State, and within such sixty-day period notifies the Administrator and the licensing or permitting agency in writing of its objection to the issuance of such license or permit and requests a public hearing on such objection, the licensing or permitting agency shall hold such a hearing. The Administrator shall at such hearing submit his evaluation and recommendations with respect to any such objection to the licensing or permitting agency. Such agency, based upon the recommendations of such State, the Administrator, and upon any additional evidence, if any, presented to the agency at the hearing, shall condition such license or permit in such manner as may be necessary to insure compliance with applicable water quality requirements. If the imposition of conditions cannot insure such compliance such agency shall not issue such license or permit.

"(3) The certification obtained pursuant to paragraph (1) of this subsection with respect to the construction of any facility shall fulfill the requirements of this subsection with respect to certification in connection with any other Federal license or permit required for the operation of such facility unless, after notice to the certifying State, agency, or Administrator, as the case may be, which shall be given by the Federal agency to whom application is made for such operating license or permit, the State, or if appropriate, the interstate agency or the Administrator, notifies such agency within sixty days after receipt of such notice that there is no longer reasonable assurance that there will be compliance with the applicable provisions of sections 301, 302, 306, and 307 of this Act because of changes since the construction license or permit certification was issued in (A) the construction or operation of the facility, (B) the characteristics of the waters into which such discharge is made, (C) the water quality criteria applicable to such waters or (D) applicable effluent limitations or other requirements. This paragraph shall be inapplicable in any case where the applicant for such operating license or permit has failed to provide the certifying State, or, if appropriate, the interstate agency or the Administrator, with notice of any proposed

changes in the construction or operation of the facility with respect to which a construction license or permit has been granted, which changes may result in violation of section 301, 302, 306, or 307 of this Act.

"(4) Prior to the initial operation of any federally licensed or permitted facility or activity which may result in any discharge into the navigable waters and with respect to which a certification has been obtained pursuant to paragraph (1) of this subsection, which facility or activity is not subject to a Federal operating license or permit, the licensee or permittee shall provide an opportunity for such certifying State, or, if appropriate, the interstate agency or the Administrator to review the manner in which the facility or activity shall be operated or conducted for the purposes of assuring that applicable effluent limitations or other limitations or other applicable water quality requirements will not be violated. Upon notification by the certifying State, or if appropriate, the interstate agency or the Administrator that the operation of any such federally licensed or permitted facility or activity will violate applicable effluent limitations or other limitations or other water quality requirements such Federal agency may, after public hearing, suspend such license or permit. If such license or permit is suspended, it shall remain suspended until notification is received from the certifying State, agency, or Administrator, as the case may be, that there is reasonable assurance that such facility or activity will not violate the applicable provisions of section 301, 302, 306, or 307 of this Act.

"(5) Any Federal license or permit with respect to which a certification has been obtained under paragraph (1) of this subsection may be suspended or revoked by the Federal agency issuing such license or permit upon the entering of a judgment under this Act that such facility or activity has been operated in violation of the applicable provisions of section 301, 302, 306, or 307 of this Act.

"(6) No Federal agency shall be deemed to be an applicant for the purposes of this subsection.

"(7) Except with respect to a permit issued under section 402 of this Act, in any case where actual construction of a facility has been lawfully commenced prior to April 3, 1970, no certification shall be required under this subsection for a license or permit issued after April 3, 1970, to operate such facility, except that any such license or permit issued without certification shall terminate April 3, 1973, unless prior to such termination date the person having such license or permit submits to the Federal agency which issued such license or permit a certification and otherwise meets the requirements of this section.

"(b) Nothing in this section shall be construed to limit the authority of any department or agency pursuant to any other provision of law to require compliance with any applicable water quality requirements. The Administrator shall, upon the request of any Federal department or agency, or State or interstate agency, or applicant, provide, for the purpose of this section, any relevant information on applicable effluent limitations, or other limitations, standards, regulations, or requirements, or water quality criteria, and shall, when requested by any such department or agency or State or interstate agency, or applicant, comment on any methods to comply with such limitations, standards, regulations, requirements, or criteria.

"(c) In order to implement the provisions of this section, the Secretary of the Army, acting through the Chief of Engineers, is authorized, if he deems it to be in the public interest, to permit the use of spoil disposal areas under his jurisdiction by Federal licensees or permittees, and to make an appropriate charge for such use. Moneys received from such licensees or permittees shall be deposited in the Treasury as miscellaneous receipts.

"(d) Any certification provided under this section shall set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a Federal license or permit will comply with any applicable effluent limitations and other limitations, under section 301 or 302 of this Act, standard of performance under section 306 of this Act, or prohibition, effluent standard, or pretreatment standard under section 307 of this Act, and with any other appropriate requirement of State law set forth in such certification, and shall become a condition on any Federal license or permit subject to the provisions of this section.

"NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

"SEC. 402. (a)(1) Except as provided in sections 318 and 404 of this Act, the Administrator may, after opportunity for public hearing, issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 301(a), upon condition that such discharge will meet either all applicable requirements under sections 301, 302, 306, 307, 308, and 403 of this Act, or prior to the taking of necessary implementing actions relating to all such requirements, such conditions as the Administrator determines are necessary to carry out the provisions of this Act.

"(2) The Administrator shall prescribe conditions for such permits to assure compliance with the requirements of paragraph (1) of this subsection, including conditions on data and information collection, reporting, and such other requirements as he deems appropriate.

"(3) The permit program of the Administrator under paragraph (1) of this subsection, and permits issued thereunder, shall be subject to the same terms, conditions, and requirements as apply to a State permit program and permits issued thereunder under subsection (b) of this section.

"(4) All permits for discharges into the navigable waters issued pursuant to section 13 of the Act of March 3, 1899, shall be deemed to be permits issued under this title, and permits issued under this title shall be deemed to be permits issued under section 13 of the Act of March 3, 1899, and shall continue in force and effect for their term unless revoked, modified, or suspended in accordance with the provisions of this Act.

"(5) No permit for a discharge into the navigable waters shall be issued under section 13 of the Act of March 3, 1899, after the date of enactment of this title. Each application for a permit under section 13 of the Act of March 3, 1899, pending on the date of enactment of this Act shall be deemed to be an application for a permit under this section. The Administrator shall authorize a State, which he determines has the capability of administering a permit program which will carry out the objective of this Act, to issue permits for discharges into the navigable waters within the jurisdiction of such State. The Administrator may exercise the authority granted him by the preceding sentence only during the period which begins on the date of enactment of this Act and ends either on the ninetieth day after the date of the first promulgation of guidelines required by section 304(h)(2) of this Act, or the date of approval by the Administrator of a permit program for such State under subsection (b) of this section, whichever date first occurs, and no such authorization to a State shall extend beyond the last day of such period. Each such permit shall be subject to such conditions as the Administrator determines are necessary to carry out the provisions of this Act. No such permit shall issue if the Administrator objects to such issuance.

"(b) At any time after the promulgation of the guidelines required by subsection (h)(2) of section 304 of this Act, the Governor of each State desiring to administer its own permit program for discharges into navigable waters within its jurisdiction may submit to the Administrator a full and complete description of the program it proposes to establish and administer under State law or under an interstate compact. In addition, such State shall submit a statement from the attorney general (or the attorney for those State water pollution control agencies which have independent legal counsel), or from the chief legal officer in the case of an interstate agency, that the laws of such State, or the interstate compact, as the case may be, provide adequate authority to carry out the described program. The Administrator shall approve each such submitted program unless he determines that adequate authority does not exist:

"(1) To issue permits which—

"(A) apply, and insure compliance with, any applicable requirements of sections 301, 302, 306, 307, and 403;

"(B) are for fixed terms not exceeding five years; and

"(C) can be terminated or modified for cause including, but not limited to, the following:

"(i) violation of any condition of the permit;

"(ii) obtaining a permit by misrepresentation, or failure to disclose fully all relevant facts;

"(iii) change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge;

"(D) control the disposal of pollutants into wells;

"(2)(A) To issue permits which apply, and insure compliance with, all applicable requirements of section 308 of this Act, or

"(B) To inspect, monitor, enter, and require reports to at least the same extent as required in section 308 of this Act;

"(3) To insure that the public, and any other State the waters of which may be affected, receive notice of each application for a permit and to provide an opportunity for public hearing before a ruling on each such application;

"(4) To insure that the Administrator receives notice of each application (including a copy thereof) for a permit;

"(5) To insure that any State (other than the permitting State), whose waters may be affected by the issuance of a permit may submit written recommendations to the permitting State (and the Administrator) with respect to any permit application and, if any part of such written recommendations are not accepted by the permitting State, that the permitting State will notify such affected State (and the Administrator) in writing of its failure to so accept such recommendations together with its reasons for so doing;

"(6) To insure that no permit will be issued if, in the judgment of the Secretary of the Army acting through the Chief of Engineers, after consultation with the Secretary of the department in which the Coast Guard is operating, anchorage and navigation of any of the navigable waters would be substantially impaired thereby;

"(7) To abate violations of the permit or the permit program, including civil and criminal penalties and other ways and means of enforcement;

"(8) To insure that any permit for a discharge from a publicly

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owned treatment works includes conditions to require adequate notice to the permitting agency of (A) new introductions into such works of pollutants from any source which would be a new source as defined in section 306 if such source were discharging pollutants, (B) new introductions of pollutants into such works from a source which would be subject to section 301 if it were discharging such pollutants, or (C) a substantial change in volume or character of pollutants being introduced into such works by a source introducing pollutants into such works at the time of issuance of the permit. Such notice shall include information on the quality and quantity of effluent to be introduced into such treatment works and any anticipated impact of such change in the quantity or quality of effluent to be discharged from such publicly owned treatment works; and

"(9) To insure that any industrial user of any publicly owned treatment works will comply with sections 204(b), 307, and 308.

"(c)(1) Not later than ninety days after the date on which a State has submitted a program (or revision thereof) pursuant to subsection (b) of this section, the Administrator shall suspend the issuance of permits under subsection (a) of this section as to those navigable waters subject to such program unless he determines that the State permit program does not meet the requirements of subsection (b) of this section or does not conform to the guidelines issued under section 304(h)(2) of this Act. If the Administrator so determines, he shall notify the State of any revisions or modifications necessary to conform to such requirements or guidelines.

"(2) Any State permit program under this section shall at all times be in accordance with this section and guidelines promulgated pursuant to section 304(h)(2) of this Act.

"(3) Whenever the Administrator determines after public hearing that a State is not administering a program approved under this section in accordance with requirements of this section, he shall so notify the State and, if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days, the Administrator shall withdraw approval of such program. The Administrator shall not withdraw approval of any such program unless he shall first have notified the State, and made public, in writing, the reasons for such withdrawal.

"(d)(1) Each State shall transmit to the Administrator a copy of each permit application received by such State and provide notice to the Administrator of every action related to the consideration of such permit application, including each permit proposed to be issued by such State.

"(2) No permit shall issue (A) if the Administrator within ninety days of the date of his notification under subsection (b)(5) of this section objects in writing to the issuance of such permit, or (B) if the Administrator within ninety days of the date of transmittal of the proposed permit by the State objects in writing to the issuance of such permit as being outside the guidelines and requirements of this Act.

"(3) The Administrator may, as to any permit application, waive paragraph (2) of this subsection.

"(e) In accordance with guidelines promulgated pursuant to subsection (h)(2) of section 304 of this Act, the Administrator is authorized to waive the requirements of subsection (d) of this section at the time he approves a program pursuant to subsection (b) of this section for any category (including any class, type, or size within such category) of point sources within the State submitting such program.

"(f) The Administrator shall promulgate regulations establishing categories of point sources which he determines shall not be subject to the requirements of subsection (d) of this section in any State with a program approved pursuant to subsection (b) of this section. The Administrator may distinguish among classes, types, and sizes within any category of point sources.

"(g) Any permit issued under this section for the discharge of pollutants into the navigable waters from a vessel or other floating craft shall be subject to any applicable regulations promulgated by the Secretary of the department in which the Coast Guard is operating, establishing specifications for safe transportation, handling, carriage, storage, and stowage of pollutants.

"(h) In the event any condition of a permit for discharges from a treatment works (as defined in section 212 of this Act) which is publicly owned is violated, a State with a program approved under subsection (b) of this section or the Administrator, where no State program is approved, may proceed in a court of competent jurisdiction to restrict or prohibit the introduction of any pollutant into such treatment works by a source not utilizing such treatment works prior to the finding that such condition was violated.

"(i) Nothing in this section shall be construed to limit the authority of the Administrator to take action pursuant to section 309 of this Act.

"(j) A copy of each permit application and each permit issued under this section shall be available to the public. Such permit application or permit, or portion thereof, shall further be available on request for the purpose of reproduction.

"(k) Compliance with a permit issued pursuant to this section shall be deemed compliance, for purposes of sections 309 and 505, with sections 301, 302, 306, 307, and 403, except any standard imposed under section 307 for a toxic pollutant injurious to human health. Until December 31, 1974, in any case where a permit for discharge has been applied for pursuant to this section, but final administrative disposition of such application has not been made, such discharge shall not be a violation of (1) section 301, 306, or 402 of this Act, or (2) section 13 of the Act of March 3, 1899, unless the Administrator or other plaintiff proves that final administrative disposition of such application has not been made because of the failure of the applicant to furnish information reasonably required or requested in order to process the application. For the 180-day period beginning on the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, in the case of any point source discharging any pollutant or combination of pollutants immediately prior to such date of enactment which source is not subject to section 13 of the Act of March 3, 1899, the discharge by such source shall not be a violation of this Act if such a source applies for a permit for discharge pursuant to this section within such 180-day period.

"OCEAN DISCHARGE CRITERIA

"SEC. 403. (a) No permit under section 402 of this Act for a discharge into the territorial sea, the waters of the contiguous zone, or the oceans shall be issued, after promulgation of guidelines established under subsection (c) of this section, except in compliance with such guidelines. Prior to the promulgation of such guidelines, a permit may be issued under such section 402 if the Administrator determines it to be in the public interest.

"(b) The requirements of subsection (d) of section 402 of this Act may not be waived in the case of permits for discharges into the territorial sea.

"(c)(1) The Administrator shall, within one hundred and eighty days after enactment of this Act (and from time to time thereafter), promulgate guidelines for determining the degradation of the waters of the territorial seas, the contiguous zone, and the oceans, which shall include:

"(A) the effect of disposal of pollutants on human health or welfare, including but not limited to plankton, fish, shellfish, wildlife, shorelines, and beaches;

"(B) the effect of disposal of pollutants on marine life including the transfer, concentration, and dispersal of pollutants or their byproducts through biological, physical, and chemical processes; changes in marine ecosystem diversity, productivity, and stability; and species and community population changes;

"(C) the effect of disposal, of pollutants on esthetic, recreation, and economic values;

"(D) the persistence and permanence of the effects of disposal of pollutants;

"(E) the effect of the disposal at varying rates, of particular volumes and concentrations of pollutants;

"(F) other possible locations and methods of disposal or recycling of pollutants including land-based alternatives; and

"(G) the effect on alternate uses of the oceans, such as mineral exploitation and scientific study.

"(2) In any event where insufficient information exists on any proposed discharge to make a reasonable judgment on any of the guidelines established pursuant to this subsection no permit shall be issued under section 402 of this Act.

"PERMITS FOR DREDGED OR FILL MATERIAL

"SEC. 404. (a) The Secretary of the Army, acting through the Chief of Engineers, may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into the navigable waters at specified disposal sites.

"(b) Subject to subsection (c) of this section, each such disposal site shall be specified for each such permit by the Secretary of the Army (1) through the application of guidelines developed by the Administrator, in conjunction with the Secretary of the Army, which guidelines shall be based upon criteria comparable to the criteria applicable to the territorial seas, the contiguous zone, and the ocean under section 403(c), and (2) in any case where such guidelines under clause (1) alone would prohibit the specification of a site, through the application additionally of the economic impact of the site on navigation and anchorage.

"(c) The Administrator is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site, and he is authorized to deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site, whenever he determines, after notice and opportunity for public hearings, that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas. Before making such determination, the Administrator shall consult with the Secretary of the Army. The Administrator shall set forth in writing and make public his findings and his reasons for making any determination under this subsection.

"DISPOSAL OF SEWAGE SLUDGE

"SEC. 405. (a) Notwithstanding any other provision of this Act or of any other law, in any case where the disposal of sewage sludge resulting from the operation of a treatment works as defined in section 212 of this Act (including the removal of in-place sewage sludge from one location and its deposit at another location) would result in any pollutant from such sewage sludge entering the navigable waters, such disposal is prohibited except in accordance with a permit issued by the Administrator under this section.

"(b) The Administrator shall issue regulations governing the issuance of permits for the disposal of sewage sludge subject to this section. Such regulations shall require the application to such disposal of each criterion, factor, procedure, and requirement applicable to a permit issued under section 402 of this title, as the Administrator determines necessary to carry out the objective of this Act.

"(c) Each State desiring to administer its own permit program for disposal of sewage sludge within its jurisdiction may do so if upon submission of such program the Administrator determines such program is adequate to carry out the objective of this Act.

"TITLE V—GENERAL PROVISIONS

"ADMINISTRATION

"SEC. 501. (a) The Administrator is authorized to prescribe such regulations as are necessary to carry out his functions under this Act.

"(b) The Administrator, with the consent of the head of any other agency of the United States, may utilize such officers and employees of such agency as may be found necessary to assist in carrying out the purposes of this Act.

"(c) Each recipient of financial assistance under this Act shall keep such records as the Administrator shall prescribe, including records which fully disclose the amount and disposition by such recipient of the proceeds of such assistance, the total cost of the project or undertaking in connection with which such assistance is given or used, and the amount of that portion of the cost of the project or undertaking supplied by other sources, and such other records as will facilitate an effective audit.

"(d) The Administrator and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for the purpose of audit and examination, to any books, documents, papers, and records of the recipients that are pertinent to the grants received under this Act.

"(e) (1) It is the purpose of this subsection to authorize a program which will provide official recognition by the United States Government to those industrial organizations and political subdivisions of States which during the preceding year demonstrated an outstanding technological achievement or an innovative process, method, or device in their waste treatment and pollution abatement programs. The Administrator shall, in consultation with the appropriate State water pollution control agencies, establish regulations under which such recognition may be applied for and granted, except that no applicant shall be eligible for an award under this subsection if such applicant is not in total compliance with all applicable water quality requirements under this Act, or otherwise does not have a satisfactory record with respect to environmental quality.

"(2) The Administrator shall award a certificate or plaque of suitable design to each industrial organization or political subdivision which qualifies for such recognition under regulations established under this subsection.

"(3) The President of the United States, the Governor of the appropriate State, the Speaker of the House of Representatives, and the President pro tempore of the Senate shall be notified of the award by the Administrator and the awarding of such recognition shall be published in the Federal Register.

"(f) Upon the request of a State water pollution control agency, personnel of the Environmental Protection Agency may be detailed to such agency for the purpose of carrying out the provisions of this Act.

"GENERAL DEFINITIONS

"SEC. 502. Except as otherwise specifically provided, when used in this Act:

"(1) The term 'State water pollution control agency' means the State agency designated by the Governor having responsibility for enforcing State laws relating to the abatement of pollution.

"(2) The term 'interstate agency' means an agency of two or more States established by or pursuant to an agreement or compact approved by the Congress, or any other agency of two or more States, having substantial powers or duties pertaining to the control of pollution as determined and approved by the Administrator.

"(3) The term 'State' means a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Trust Territory of the Pacific Islands.

"(4) The term 'municipality' means a city, town, borough, county, parish, district, association, or other public body created by or pursuant to State law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of this Act.

"(5) The term 'person' means an individual, corporation, partnership, association, State, municipality, commission, or political subdivision of a State, or any interstate body.

"(6) The term 'pollutant' means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. This term does not mean (A) 'sewage from vessels' within the meaning of section 312 of this Act; or (B) water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if such State determines that such injection or disposal will not result in the degradation of ground or surface water resources.

"(7) The term 'navigable waters' means the waters of the United States, including the territorial seas.

"(8) The term 'territorial seas' means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles.

"(9) The term 'contiguous zone' means the entire zone established or to be established by the United States under article 24 of the Convention of the Territorial Sea and the Contiguous Zone.

"(10) The term 'ocean' means any portion of the high seas beyond the contiguous zone.

"(11) The term 'effluent limitation' means any restriction established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean, including schedules of compliance.

"(12) The term 'discharge of a pollutant' and the term 'discharge of pollutants' each means (A) any addition of any pollutant to navigable waters from any point source, (B) any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft.

"(13) The term 'toxic pollutant' means those pollutants, or combinations of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will, on the basis of information available to the Administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

"(14) The term 'point source' means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.

"(15) The term 'biological monitoring' shall mean the determination of the effects on aquatic life, including accumulation of pollutants in tissue, in receiving waters due to the discharge of pollutants (A) by techniques and procedures, including sampling of organisms representative of appropriate levels of the food chain appropriate to the volume and the physical, chemical, and biological characteristics of the effluent, and (B) at appropriate frequencies and locations.

"(16) The term 'discharge' when used without qualification includes a discharge of a pollutant, and a discharge of pollutants.

"(17) The term 'schedule of compliance' means a schedule of remedial measures including an enforceable sequence of actions or operations leading to compliance with an effluent limitation, other limitation, prohibition, or standard.

"(18) The term 'industrial user' means those industries identified in the Standard Industrial Classification Manual, Bureau of the Budget, 1967, as amended and supplemented, under the category 'Division D—Manufacturing' and such other classes of significant waste producers as, by regulation, the Administrator deems appropriate.

"(19) The term 'pollution' means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.

"WATER POLLUTION CONTROL ADVISORY BOARD

"SEC. 503. (a) (1) There is hereby established in the Environmental Protection Agency a Water Pollution Control Advisory Board, composed of the Administrator or his designee, who shall be Chairman, and nine members appointed by the President, none of whom shall be Federal officers or employees. The appointed members, having due regard for the purposes of this Act, shall be selected from among representatives of various State, interstate, and local governmental agencies, of public or private interests contributing to, affected by, or

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concerned with pollution, and of other public and private agencies, organizations, or groups demonstrating an active interest in the field of pollution prevention and control, as well as other individuals who are expert in this field.

"(2)(A) Each member appointed by the President shall hold office for a term of three years, except that (i) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term, and (ii) the terms of office of the members first taking office after June 30, 1956, shall expire as follows: three at the end of one year after such date, three at the end of two years after such date, and three at the end of three years after such date, as designated by the President at the time of appointment, and (iii) the term of any member under the preceding provisions shall be extended until the date on which his successor's appointment is effective. None of the members appointed by the President shall be eligible for reappointment within one year after the end of his preceding term.

"(B) The members of the Board who are not officers or employees of the United States, while attending conferences or meetings of the Board or while otherwise serving at the request of the Administrator, shall be entitled to receive compensation at a rate to be fixed by the Administrator, but not exceeding $100 per diem, including travel-time, and while away from their homes or regular places of business they may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by law (5 U.S.C. 73b-2) for persons in the Government service employed intermittently.

"(b) The Board shall advise, consult with, and make recommendations to the Administrator on matters of policy relating to the activities and functions of the Administrator under this Act.

"(c) Such clerical and technical assistance as may be necessary to discharge the duties of the Board shall be provided from the personnel of the Environmental Protection Agency.

"EMERGENCY POWERS

"SEC. 504. Notwithstanding any other provision of this Act, the Administrator upon receipt of evidence that a pollution source or combination of sources is presenting an imminent and substantial endangerment to the health of persons or to the welfare of persons where such endangerment is to the livelihood of such persons, such as inability to market shellfish, may bring suit on behalf of the United States in the appropriate district court to immediately restrain any person causing or contributing to the alleged pollution to stop the discharge of pollutants causing or contributing to such pollution or to take such other action as may be necessary.

"CITIZEN SUITS

"SEC. 505. (a) Except as provided in subsection (b) of this section, any citizen may commence a civil action on his own behalf—

"(1) against any person (including (i) the United States, and (ii) any other governmental instrumentality or agency to the extent permitted by the eleventh amendment to the Constitution) who is alleged to be in violation of (A) an effluent standard or limitation under this Act or (B) an order issued by the Administrator or a State with respect to such a standard or limitation, or

"(2) against the Administrator where there is alleged a failure of the Administrator to perform any act or duty under this Act which is not discretionary with the Administrator.

The district courts shall have jurisdiction, without regard to the amount in controversy or the citizenship of the parties, to enforce such an effluent standard or limitation, or such an order, or to order the Administrator to perform such act or duty, as the case may be, and to apply any appropriate civil penalties under section 309(d) of this Act.

"(b) No action may be commenced—

"(1) under subsection (a)(1) of this section—

"(A) prior to sixty days after the plaintiff has given notice of the alleged violation (i) to the Administrator, (ii) to the State in which the alleged violation occurs, and (iii) to any alleged violator of the standard, limitation, or order, or

"(B) if the Administrator or State has commenced and is diligently prosecuting a civil or criminal action in a court of the United States, or a State to require compliance with the standard, limitation, or order, but in any such action in a court of the United States any citizen may intervene as a matter of right.

"(2) under subsection (a)(2) of this section prior to sixty days after the plaintiff has given notice of such action to the Administrator,

except that such action may be brought immediately after such notification in the case of an action under this section respecting a violation of sections 306 and 307(a) of this Act. Notice under this subsection shall be given in such manner as the Administrator shall prescribe by regulation.

"(c)(1) Any action respecting a violation by a discharge source of an effluent standard or limitation or an order respecting such standard or limitation may be brought under this section only in the judicial district in which such source is located.

"(2) In such action under this section, the Administrator, if not a party, may intervene as a matter of right.

"(d) The court, in issuing any final order in any action brought pursuant to this section, may award costs of litigation (including reasonable attorney and expert witness fees) to any party, whenever the court determines such award is appropriate. The court may, if a temporary restraining order or preliminary injunction is sought, require the filing of a bond or equivalent security in accordance with the Federal Rules of Civil Procedure.

"(e) Nothing in this section shall restrict any right which any person (or class of persons) may have under any statute or common law to seek enforcement of any effluent standard or limitation or to seek any other relief (including relief against the Administrator or a State agency).

"(f) For purposes of this section, the term 'effluent standard or limitation under this Act' means (1) effective July 1, 1973, an unlawful act under subsection (a) of section 301 of this Act; (2) an effluent limitation or other limitation under section 301 or 302 of this Act; (3) standard of performance under section 306 of this Act; (4) prohibition, effluent standard or pretreatment standards under section 307 of this Act; (5) certification under section 401 of this Act; or (6) a permit or condition thereof issued under section 402 of this Act, which is in effect under this Act (including a requirement applicable by reason of section 313 of this Act).

"(g) For the purposes of this section the term 'citizen' means a person or persons having an interest which is or may be adversely affected.

"(h) A Governor of a State may commence a civil action under subsection (a), without regard to the limitations of subsection (b) of this section, against the Administrator where there is alleged a failure of the Administrator to enforce an effluent standard or limitation under this Act the violation of which is occurring in another State and is causing an adverse effect on the public health or welfare in his State, or is causing a violation of any water quality requirement in his State.

"APPEARANCE

"SEC. 506. The Administrator shall request the Attorney General to appear and represent the United States in any civil or criminal action instituted under this Act to which the Administrator is a party. Unless the Attorney General notifies the Administrator within a reasonable time, that he will appear in a civil action, attorneys who are officers or employees of the Environmental Protection Agency shall appear and represent the United States in such action.

"EMPLOYEE PROTECTION

"SEC. 507. (a) No person shall fire, or in any other way discriminate against, or cause to be fired or discriminated against, any employee or any authorized representative of employees by reason of the fact that such employee or representative has filed, instituted, or caused to be filed or instituted any proceeding under this Act, or has testified or is about to testify in any proceeding resulting from the administration or enforcement of the provisions of this Act.

"(b) Any employee or a representative of employees who believes that he has been fired or otherwise discriminated against by any person in violation of subsection (a) of this section may, within thirty days after such alleged violation occurs, apply to the Secretary of Labor for a review of such firing or alleged discrimination. A copy of the application shall be sent to such person who shall be the respondent. Upon receipt of such application, the Secretary of Labor shall cause such investigation to be made as he deems appropriate. Such investigation shall provide an opportunity for a public hearing at the request of any party to such review to enable the parties to present information relating to such alleged violation. The parties shall be given written notice of the time and place of the hearing at least five days prior to the hearing. Any such hearing shall be of record and shall be subject to section 554 of title 5 of the United States Code. Upon receiving the report of such investigation, the Secretary of Labor shall make findings of fact. If he finds that such violation did occur, he shall issue a decision, incorporating an order therein and his findings, requiring the party committing such violation to take such affirmative action to abate the violation as the Secretary of Labor deems appropriate, including, but not limited to, the rehiring or reinstatement of the employee or representative of employees to his former position with compensation. If he finds that there was no such violation, he shall issue an order denying the application. Such order issued by the Secretary of Labor under this subparagraph shall be subject to judicial review in the same manner as orders and decisions of the Administrator are subject to judicial review under this Act.

"(c) Whenever an order is issued under this section to abate such violation, at the request of the applicant, a sum equal to the aggregate amount of all costs and expenses (including the attorney's fees), as determined by the Secretary of Labor, to have been reasonably incurred by the applicant for, or in connection with, the institution and prosecution of such proceedings, shall be assessed against the person committing such violation.

"(d) This section shall have no application to any employee who, acting without direction from his employer (or his agent) deliberately

violates any prohibition of effluent limitation or other limitaton under section 301 or 302 of this Act, standards of performance under section 306 of this Act, effluent standard, prohibition or pretreatment standard under section 307 of this Act, or any other prohibition or limitation established under this Act.

"(e) The Administrator shall conduct continuing evaluations of potential loss or shifts of employment which may result from the issuance of any effluent limitation or order under this Act, including, where appropriate, investigating threatened plant closures or reductions in employment allegedly resulting from such limitation or order. Any employee who is discharged or laid-off, threatened with discharge or lay-off, or otherwise discriminated against by any person because of the alleged results of any effluent limitation or order issued under this Act, or any representative of such employee, may request the Administrator to conduct a full investigation of the matter. The Administrator shall thereupon investigate the matter and, at the request of any party, shall hold public hearings on not less than five days notice, and shall at such hearings require the parties, including the employer involved, to present information relating to the actual or potential effect of such limitation or order on employment and on any alleged discharge, lay-off, or other discrimination and the detailed reasons or justification therefor. Any such hearing shall be of record and shall be subject to section 554 of title 5 of the United States Code. Upon receiving the report of such investigation, the Administrator shall make findings of fact as to the effect of such effluent limitation or order on employment and on the alleged discharge, lay-off, or discrimination and shall make such recommendations as he deems appropriate. Such report, findings, and recommendations shall be available to the public. Nothing in this subsection shall be construed to require or authorize the Administrator to modify or withdraw any effluent limitation or order issued under this Act.

"FEDERAL PROCUREMENT

"SEC. 508. (a) No Federal agency may enter into any contract with any person, who has been convicted of any offense under section 309 (c) of this Act, for the procurement of goods, materials, and services if such contract is to be performed at any facility at which the violation which gave rise to such conviction occurred, and if such facility is owned, leased, or supervised by such person. The prohibition in the preceding sentence shall continue until the Administrator certifies that the condition giving rise to such conviction has been corrected.

"(b) The Administrator shall establish procedures to provide all Federal agencies with the notification necessary for the purposes of subsection (a) of this section.

"(c) In order to implement the purposes and policy of this Act to protect and enhance the quality of the Nation's water, the President shall, not more than one hundred and eighty days after enactment of this Act, cause to be issued an order (1) requiring each Federal agency authorized to enter into contracts and each Federal agency which is empowered to extend Federal assistance by way of grant, loan, or contract to effectuate the purpose and policy of this Act in such contracting or assistance activities, and (2) setting forth procedures, sanctions, penalties, and such other provisions, as the President determines necessary to carry out such requirement.

"(d) The President may exempt any contract, loan, or grant from all or part of the provisions of this section where he determines such exemption is necessary in the paramount interest of the United States and he shall notify the Congress of such exemption.

"(e) The President shall annually report to the Congress on measures taken in compliance with the purpose and intent of this section, including, but not limited to, the progress and problems associated with such compliance.

"ADMINISTRATIVE PROCEDURE AND JUDICIAL REVIEW

"SEC. 509. (a)(1) For purposes of obtaining information under section 305 of this Act, or carrying out section 507(e) of this Act, the Administrator may issue subpenas for the attendance and testimony of witnesses and the production of relevant papers, books, and documents, and he may administer oaths. Except for effluent data, upon a showing satisfactory to the Administrator that such papers, books, documents, or information or particular part thereof, if made public, would divulge trade secrets or secret processes, the Administrator shall consider such record, report, or information or particular portion thereof confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such paper, book, document, or information may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out this Act, or when relevant in any proceeding under this Act. Witnesses summoned shall be paid the same fees and mileage that are paid witnesses in the courts of the United States. In case of contumacy or refusal to obey a subpena served upon any person under this subsection, the district court of the United States for any district in which such person is found or resides or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony before the Administrator, to appear and produce papers, books, and documents before the Administrator, or both, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

"(2) The district courts of the United States are authorized, upon application by the Administrator, to issue subpenas for attendance and testimony of witnesses and the production of relevant papers, books, and documents, for purposes of obtaining information under sections 304 (b) and (c) of this Act. Any papers, books, documents, or other information or part thereof, obtained by reason of such a subpena shall be subject to the same requirements as are provided in paragraph (1) of this subsection.

"(b)(1) Review of the Administrator's action (A) in promulgating any standard of performance under section 306, (B) in making any determination pursuant to section 306(b)(1)(C), (C) in promulgating any effluent standard, prohibition, or pretreatment standard under section 307, (D) in making any determination as to a State permit program submitted under section 402(b), (E) in approving or promulgating any effluent limitation or other limitation under section 301, 302, or 306, and (F) in issuing or denying any permit under section 402, may be had by any interested person in the Circuit Court of Appeals of the United States for the Federal judicial district in which such person resides or transacts such business upon application by such person. Any such application shall be made within ninety days from the date of such determination, approval, promulgation, issuance or denial, or after such date only if such application is based solely on grounds which arose after such ninetieth day.

"(2) Action of the Administrator with respect to which review could have been obtained under paragraph (1) of this subsection shall not be subject to judicial review in any civil or criminal proceeding for enforcement.

"(c) In any judicial proceeding brought under subsection (b) of this section in which review is sought of a determination under this Act required to be made on the record after notice and opportunity for hearing, if any party applies to the court for leave to adduce additional evidence, and shows to the satisfaction of the court that such additional evidence is material and that there were reasonable grounds for the failure to adduce such evidence in the proceeding before the Administrator, the court may order such additional evidence (and evidence in rebuttal thereof) to be taken before the Administrator, in such manner and upon such terms and conditions as the court may deem proper. The Administrator may modify his findings as to the facts, or make new findings, by reason of the additional evidence so taken and he shall file such modified or new findings, and his recommendation, if any, for the modification or setting aside of his original determination, with the return of such additional evidence.

"STATE AUTHORITY

"SEC. 510. Except as expressly provided in this Act, nothing in this Act shall (1) preclude or deny the right of any State or political subdivision thereof or interstate agency to adopt or enforce (A) any standard or limitation respecting discharges of pollutants, or (B) any requirement respecting control or abatement of pollution; except that if an effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance is in effect under this Act, such State or political subdivision or interstate agency may not adopt or enforce any effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance which is less stringent than the effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance under this Act; or (2) be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters (including boundary waters) of such States.

"OTHER AFFECTED AUTHORITY

"SEC. 511. (a) This Act shall not be construed as (1) limiting the authority or functions of any officer or agency of the United States under any other law or regulation not inconsistent with this Act; (2) affecting or impairing the authority of the Secretary of the Army (A) to maintain navigation or (B) under the Act of March 3, 1899 (30 Stat. 1112); except that any permit issued under section 404 of this Act shall be conclusive as to the effect on water quality of any discharge resulting from any activity subject to section 10 of the Act of March 3, 1899, or (3) affecting or impairing the provisions of any treaty of the United States.

"(b) Discharges of pollutants into the navigable waters subject to the Rivers and Harbors Act of 1910 (36 Stat. 593; 33 U.S.C. 421) and the Supervisory Harbors Act of 1888 (25 Stat. 209; 33 U.S.C. 441–451b) shall be regulated pursuant to this Act, and not subject to such Act of 1910 and the Act of 1888 except as to effect on navigation and anchorage.

"(c)(1) Except for the provision of Federal financial assistance for the purpose of assisting the construction of publicly owned treatment works as authorized by section 201 of this Act, and the issuance of a permit under section 402 of this Act for the discharge of any

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pollutant by a new source as defined in section 306 of this Act, no action of the Administrator taken pursuant to this Act shall be deemed a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969 (83 Stat. 852); and

"(2) Nothing in the National Environmental Policy Act of 1969 (83 Stat. 852) shall be deemed to—

"(A) authorize any Federal agency authorized to license or permit the conduct of any activity which may result in the discharge of a pollutant into the navigable waters to review any effluent limitation or other requirement established pursuant to this Act or the adequacy of any certification under section 401 of this Act; or

"(B) authorize any such agency to impose, as a condition precedent to the issuance of any license or permit, any effluent limitation other than any such limitation established pursuant to this Act.

(d) Notwithstanding this Act or any other provision of law, the Administrator (1) shall not require any State to consider in the development of the ranking in order of priority of needs for the construction of treatment works (as defined in title II of this Act), any water pollution control agreement which may have been entered into between the United States and any other nation, and (2) shall not consider any such agreement in the approval of any such priority ranking.

"SEPARABILITY

"SEC. 512. If any provision of this Act, or the application of any provision of this Act to any person or circumstance, is held invalid, the application of such provision to other persons or circumstances, and the remainder of this Act, shall not be affected thereby.

"LABOR STANDARDS

"SEC. 513. The Administrator shall take such action as may be necessary to insure that all laborers and mechanics employed by contractors or subcontractors on treatment works for which grants are made under this Act shall be paid wages at rates not less than those prevailing for the same type of work on similar construction in the immediate locality, as determined by the Secretary of Labor, in accordance with the Act of March 3, 1931, as amended, known as the Davis-Bacon Act (46 Stat. 1494; 40 U.S.C., sec. 276a through 276a-5). The Secretary of Labor shall have, with respect to the labor standards specified in this subsection, the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (15 F.R. 3176) and section 2 of the Act of June 13, 1934, as amended (48 Stat. 948; 40 U.S.C. 276c).

"PUBLIC HEALTH AGENCY COORDINATION

"SEC. 514. The permitting agency under section 402 shall assist the applicant for a permit under such section in coordinating the requirements of this Act with those of the appropriate public health agencies.

"EFFLUENT STANDARDS AND WATER QUALITY INFORMATION ADVISORY COMMITTEE

"SEC. 515. (a) (1) There is established on Effluent Standards and Water Quality Information Advisory Committee, which shall be composed of a Chairman and eight members who shall be appointed by the Administrator within sixty days after the date of enactment of this Act.

"(2) All members of the Committee shall be selected from the scientific community, qualified by education, training, and experience to provide, assess, and evaluate scientific and technical information on effluent standards and limitations.

"(3) Members of the Committee shall serve for a term of four years, and may be reappointed.

"(b) (1) No later than one hundred and eighty days prior to the date on which the Administrator is required to publish any proposed regulations required by section 304(b) of this Act, any proposed standard of performance for new sources required by section 306 of this Act, or any proposed toxic effluent standard required by section 307 of this Act, he shall transmit to the Committee a notice of intent to propose such regulations. The Chairman of the Committee within ten days after receipt of such notice may publish a notice of a public hearing by the Committee, to be held within thirty days.

"(2) No later than one hundred and twenty days after receipt of such notice, the Committee shall transmit to the Administrator such scientific and technical information as is in its possession, including that presented at any public hearing, related to the subject matter named in such notice.

"(3) Information so transmitted to the Administrator shall constitute a part of the administrative record and comments on any proposed regulations or standards as information to be considered with other comments and information in making any final determinations.

"(4) In preparing information for transmittal, the Committee shall avail itself of the technical and scientific services of any Federal agency, including the United States Geological Survey and any national environmental laboratories which may be established.

"(c) (1) The Committee shall appoint and prescribe the duties of a Secretary, and such legal counsel as it deems necessary. The Committee shall appoint such other employees as it deems necessary to exercise and fulfill its powers and responsibilities. The compensation of all employees appointed by the Committee shall be fixed in accordance with chapter 51 and subchapter III of chapter 53 of title V of the United States Code.

"(2) Members of the Committee shall be entitled to receive compensation at a rate to be fixed by the President but not in excess of the maximum rate of pay for grade GS–18, as provided in the General Schedule under section 5332 of title V of the United States Code.

"(d) Five members of the Committee shall constitute a quorum, and official actions of the Committee shall be taken only on the affirmative vote of at least five members. A special panel composed of one or more members upon order of the Committee shall conduct any hearing authorized by this section and submit the transcript of such hearing to the entire Committee for its action thereon.

"(e) The Committee is authorized to make such rules as are necessary for the orderly transaction of its business.

"REPORTS TO CONGRESS

"SEC. 516. (a) Within ninety days following the convening of each session of Congress, the Administrator shall submit to the Congress a report, in addition to any other report required by this Act, on measures taken toward implementing the objective of this Act, including, but not limited to, (1) the progress and problems associated with developing comprehensive plans under section 102 of this Act, area-wide plans under section 208 of this Act, basin plans under section 209 of this Act, and plans under section 303(e) of this Act; (2) a summary of actions taken and results achieved in the field of water pollution control research, experiments, studies, and related matters by the Administrator and other Federal agencies and by other persons and agencies under Federal grants or contracts; (3) the progress and problems associated with the development of effluent limitations and recommended control techniques; (4) the status of State programs, including a detailed summary of the progress obtained as compared to that planned under State program plans for development and enforcement of water quality requirements; (5) the identification and status of enforcement actions pending or completed under such Act during the preceding year; (6) the status of State, interstate, and local pollution control programs established pursuant to, and assisted by, this Act; (7) a summary of the results of the survey required to be taken under section 210 of this Act; (8) his activities including recommendations under sections 109 through 111 of this Act; and (9) all reports and recommendations made by the Water Pollution Control Advisory Board.

(b) (1) The Administrator, in cooperation with the States, including water pollution control agencies and other water pollution control planning agencies, shall make (A) a detailed estimate of the cost of carrying out the provisions of this Act; (B) a detailed estimate, biennially revised, of the cost of construction of all needed publicly owned treatment works in all of the States and of the cost of construction of all needed publicly owned treatment works in each of the States; (C) a comprehensive study of the economic impact on affected units of government of the cost of installation of treatment facilities; and (D) a comprehensive analysis of the national requirements for and the cost of treating municipal, industrial, and other effluent to attain the water quality objectives as established by this Act or applicable State law. The Administrator shall submit such detailed estimate and such comprehensive study of such cost to the Congress no later than February 10 of each odd-numbered year. Whenever the Administrator, pursuant to this subsection, requests and receives an estimate of cost from a State, he shall furnish copies of such estimate together with such detailed estimate to Congress.

(2) Notwithstanding the second sentence of paragraph (1) of this subsection, the Administrator shall make a preliminary detailed estimate called for by subparagraph (B) of such paragraph and shall submit such preliminary detailed estimate to the Congress no later than September 3, 1974. The Administrator shall require each State to prepare an estimate of cost for such State, and shall utilize the survey form EPA-1, O.M.B. No. 158-R0017, prepared for the 1973 detailed estimate, except that such estimate shall include all costs of compliance with section 201 (g) (2) (A) of this Act and water quality standards established pursuant to section 303 of this Act, and all costs of treatment works as defined in section 212 (2), including all eligible costs of constructing sewage collection systems and correcting excessive infiltration or inflow and all eligible costs of correcting combined storm and sanitary sewer problems and treating storm water flows. The survey form shall be distributed by the Administrator to each State no later than January 31, 1974.

"GENERAL AUTHORIZATION

"SEC. 517. There are authorized to be appropriated to carry out this Act, other than sections 104, 105, 106(a), 107, 108, 112, 113, 114, 115,

206, 207, 208 (f) and (h), 209, 304, 311 (c), (d), (i), (l), and (k), 314, 315, and 317, $250,000,000 for the fiscal year ending June 30, 1973, $300,000,000 for the fiscal year ending June 30, 1974, and $350,000,000 for the fiscal year ending June 30, 1975.

"SHORT TITLE

"SEC. 518. This Act may be cited as the 'Federal Water Pollution Control Act'."

AUTHORIZATIONS FOR FISCAL YEAR 1972

SEC. 3. (a) There is authorized to be appropriated for the fiscal year ending June 30, 1972, and to exceed $11,000,000 for the purpose of carrying out section 5(n) (other than for salaries and related expenses) of the Federal Water Pollution Control Act as it existed immediately prior to the date of the enactment of the Federal Water Pollution Control Act Amendments of 1972.

(b) There is hereby authorized to be appropriated for the fiscal year ending June 30, 1972, and to exceed $350,000,000 for the purpose of making grants under section 8 of the Federal Water Pollution Control Act as it existed immediately prior to the date of the enactment of the Federal Water Pollution Control Act Amendments of 1972.

(c) The Federal share of all grants made under section 8 of the Federal Water Pollution Control Act as it existed immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 from sums herein and heretofore authorized for the fiscal year ending June 30, 1972, shall be that authorized by section 202 of such Act as established by the Federal Water Pollution Control Act Amendments of 1972.

(d) Sums authorized by this section shall be in addition to any amounts heretofore authorized for such fiscal year for sections 5(n) and 8 of the Federal Water Pollution Control Act as it existed immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972.

SAVINGS PROVISION

SEC. 4. (a) No suit, action, or other proceeding lawfully commenced by or against the Administrator or any other officer or employee of the United States in his official capacity or in relation to the discharge of his official duties under the Federal Water Pollution Control Act as in effect immediately prior to the date of enactment of this Act shall abate by reason of the taking effect of the amendment made by section 2 of this Act. The court may, on its own motion or that of any party made at any time within twelve months after such taking effect, allow the same to be maintained by or against the Administrator or such officer or employee.

(b) All rules, regulations, orders, determinations, contracts, certifications, authorizations, delegations, or other actions duly issued, made, or taken by or pursuant to the Federal Water Pollution Control Act as in effect immediately prior to the date of enactment of this Act and pertaining to any functions, powers, requirements, and duties under the Federal Water Pollution Control Act as in effect immediately prior to the date of enactment of this Act, shall continue in full force and effect after the date of enactment of this Act until modified or rescinded in accordance with the Federal Water Pollution Control Act as amended by this Act.

(c) The Federal Water Pollution Control Act as in effect immediately prior to the date of enactment of this Act shall remain applicable to all grants made from funds authorized for the fiscal year ending June 30, 1972, and prior fiscal years, including any increases in the monetary amount of any such grant which may be paid from authorizations for fiscal years beginning after June 30, 1972, except as specifically otherwise provided in section 202 of the Federal Water Pollution Control Act as amended by this Act and in subsection (c) of section 3 of this Act.

OVERSIGHT STUDY

SEC. 5. In order to assist the Congress in the conduct of oversight responsibilities the Comptroller General of the United States shall conduct a study and review of the research, pilot, and demonstration programs related to prevention and control of water pollution, including waste treatment and disposal techniques, which are conducted, supported, or assisted by any agency of the Federal Government pursuant to any Federal law or regulation and assess conflicts between, and the coordination and efficacy of, such programs, and make a report to the Congress thereon by October 1, 1973.

INTERNATIONAL TRADE STUDY

SEC. 6. (a) The Secretary of Commerce, in cooperation with other interested Federal agencies and with representatives of industry and the public, shall undertake immediately an investigation and study to determine—

(1) the extent to which pollution abatement and control programs will be imposed on, or voluntarily undertaken by, United States manufacturers in the near future and the probable short- and long-range effects of the costs of such programs (computed to the greatest extent practicable on an industry-by-industry basis) on (A) the production costs of such domestic manufacturers, and (B) the market prices of the goods produced by them;

(2) the probable extent to which pollution abatement and control programs will be implemented in foreign industrial nations in the near future and the extent to which the production costs (computed to the greatest extent practicable on an industry-by-industry basis) of foreign manufacturers will be affected by the costs of such programs;

(3) the probable competitive advantage which any article manufactured in a foreign nation will likely have in relation to a comparable article made in the United States if that foreign nation—

(A) does not require its manufacturers to implement pollution abatement and control programs,

(B) requires a lesser degree of pollution abatement and control in its programs, or

(C) in any way reimburses or otherwise subsidizes its manufacturers for the costs of such program;

(4) alternative means by which any competitive advantage accruing to the products of any foreign nation as a result of any factor described in paragraph (3) may be (A) accurately and quickly determined, and (B) equalized, for example, by the imposition of a surcharge or duty, on a foreign product in an amount necessary to compensate for such advantage; and

(5) the impact, if any, which the imposition of a compensating tariff of other equalizing measure may have in encouraging foreign nations to implement pollution and abatement control programs.

(b) The Secretary shall make an initial report to the President and Congress within six months after the date of enactment of this section of the results of the study and investigation carried out pursuant to this section and shall make additional reports thereafter at such times as he deems appropriate taking into account the development of relevant data, but not less than once every twelve months.

INTERNATIONAL AGREEMENTS

SEC. 7. The President shall undertake to enter into international agreements to apply uniform standards of performance for the control of the discharge and emission of pollutants from new sources, uniform controls over the discharge and emission of toxic pollutants, and uniform controls over the discharge of pollutants into the ocean. For this purpose the President shall negotiate multilateral treaties, conventions, resolutions, or other agreements, and formulate, present, or support proposals at the United Nations and other appropriate international forums.

LOANS TO SMALL BUSINESS CONCERNS FOR WATER POLLUTION CONTROL FACILITY

SEC. 8. (a) Section 7 of the Small Business Act is amended by inserting at the end thereof a new subsection as follows:

"(g)(1) The Administration also is empowered to make loans (either directly or in cooperation with banks or other lenders through agreements to participate on an immediate or deferred basis) to assist any small business concern in affecting additions to or alterations in the equipment, facilities (including the construction of pretreatment facilities and interceptor sewers), or methods of operation of such concern to meet water pollution control requirements established under the Federal Water Pollution Control Act, if the Administration determines that such concern is likely to suffer substantial economic injury without assistance under this subsection.

"(2) Any such loan—

"(A) shall be made in accordance with provisions applicable to loans made pursuant to subsection (b)(5) of this section, except as otherwise provided in this subsection;

"(B) shall be made only if the applicant furnishes the Administration with a statement in writing from the Environmental Protection Agency or, if appropriate, the State, that such additions or alterations are necessary and adequate to comply with requirements established under the Federal Water Pollution Control Act.

"(3) The Administrator of the Environmental Protection Agency shall, as soon as practicable after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 and not later than one hundred and eighty days thereafter, promulgate regulations establishing uniform rules for the issuance of statements for the purpose of paragraph (2)(B) of this subsection.

"(4) There is authorized to be appropriated to the disaster loan fund established pursuant to section 4(c) of this Act not to exceed $800,000,000 solely for the purpose of carrying out this subsection."

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(b) Section 4(c)(1)(A) of the Small Business Act is amended striking out "and 7(c)(2)" and inserting in lieu thereof "7(c)(2), (g)".

ENVIRONMENTAL COURT

SEC. 9. The President, acting through the Attorney General, shall make a full and complete investigation and study of the feasibility of establishing a separate court, or court system, having jurisdiction over environmental matters and shall report the results of such investigation and study together with his recommendations to Congress not later than one year after the date of enactment of this Act.

NATIONAL POLICIES AND GOALS STUDY

SEC. 10. The President shall make a full and complete investigation and study of all of the national policies and goals established by law for the purpose of determining what the relationship should be between these policies and goals, taking into account the resources of the Nation. He shall report the results of such investigation and study together with his recommendations to Congress not later than two years after the date of enactment of this Act. There is authorized to be appropriated not to exceed $5,000,000 to carry out the purposes of this section.

EFFICIENCY STUDY

SEC. 11. The President shall conduct a full and complete investigation and study of ways and means of utilizing in the most effective manner all of the various resources, facilities, and personnel of the Federal Government in order most efficiently to carry out the objective of the Federal Water Pollution Control Act. He shall utilize in conducting such investigation and study, the General Accounting Office. He shall report the results of such investigation and study together with his recommendations to Congress not later than two hundred and seventy days after the date of enactment of this Act.

ENVIRONMENTAL FINANCING

SEC. 12. (a) This section may be cited as the "Environmental Financing Act of 1972".

(b) There is hereby created a body corporate to be known as the Environmental Financing Authority, which shall have succession dissolved by Act of Congress. The Authority shall be subject to general supervision and direction of the Secretary of the Treasury. The Authority shall be an instrumentality of the United States Government and shall maintain such offices as may be necessary or appropriate in the conduct of its business.

(c) The purpose of this section is to assure that inability to borrow necessary funds on reasonable terms does not prevent any State or local public body from carrying out any project for construction of waste treatment works determined eligible for assistance pursuant to subsection (e) of this section.

(d)(1) The Authority shall have a Board of Directors consisting of five persons, one of whom shall be the Secretary of the Treasury or his designee as Chairman of the Board, and four of whom shall be appointed by the President from among the officers or employees of the Authority or of any department or agency of the United States Government.

(2) The Board of Directors shall meet at the call of its Chairman. The Board shall determine the general policies which shall govern the operations of the Authority. The Chairman of the Board shall select and effect the appointment of qualified persons to fill the offices as may be provided for in the bylaws, with such executive functions, powers, and duties as may be prescribed by the bylaws or by the Board of Directors, and such persons shall be the executive officers of the Authority and shall discharge all such executive functions, powers, and duties. The members of the Board, as such, shall not receive compensation for their services.

(e)(1) Until July 1, 1975, the Authority is authorized to make commitments to purchase, and to purchase on terms and conditions determined by the Authority, any obligation or participation therein which is issued by a State or local public body to finance the non-Federal share of the cost of any project for the construction of waste treatment works which the Administrator of the Environmental Protection Agency has determined to be eligible for Federal financial assistance under the Federal Water Pollution Control Act.

(2) No commitment shall be entered into, and no purchase shall be made, unless the Administrator of the Environmental Protection Agency (A) has certified that the public body is unable to obtain on reasonable terms sufficient credit to finance its actual needs; (B) has approved the project as eligible under the Federal Water Pollution Control Act; and (C) has agreed to guarantee timely payment of principal and interest on the obligation. The Administrator is authorized to guarantee such timely payments and to issue regulations as he deems necessary and proper to protect such guarantees. Appropriations are hereby authorized to be made to the Administrator in such sums as are necessary to make payments under such guarantees, and such payments are authorized to be made from such appropriations.

(3) No purchase shall be made of obligations issued to finance projects, the permanent financing of which occurred prior to the enactment of this section.

(4) Any purchase by the Authority shall be upon such terms and conditions as to yield a return at a rate determined by the Secretary of the Treasury taking into consideration (A) the current average yield on outstanding marketable obligations of the United States of comparable maturity or in its stead whenever the Authority has sufficient of its own long-term obligations outstanding, the current average yield on outstanding obligations of the Authority of comparable maturity; and (B) the market yields on municipal bonds.

(5) The Authority is authorized to charge fees for its commitments and other services adequate to cover all expenses and to provide for the accumulation of reasonable contingency reserves and such fees shall be included in the aggregate project costs.

(f) To provide initial capital to the Authority the Secretary of the Treasury is authorized to advance the funds necessary for this purpose. Each such advance shall be upon such terms and conditions as to yield a return at a rate not less than a rate determined by the Secretary of the Treasury taking into consideration the current average yield on outstanding marketable obligations of the United States of comparable maturities. Interest payments on such advances may be deferred, at the discretion of the Secretary, but any such deferred payments shall themselves bear interest at the rate specified in this section. There is authorized to be appropriated not to exceed $100,000,000, which shall be available for the purposes of this subsection.

(g)(1) The Authority is authorized, with the approval of the Secretary of the Treasury, to issue and have outstanding obligations having such maturities and bearing such rate or rates of interest as may be determined by the Authority. Such obligations may be redeemable at the option of the Authority before maturity in such manner as may be stipulated therein.

(2) As authorized in appropriation Acts, and such authorizations may be without fiscal year limitation, the Secretary of the Treasury may in his discretion purchase or agree to purchase any obligations issued pursuant to paragraph (1) of this subsection, and for such purpose the Secretary of the Treasury is authorized to use as a public debt transaction the proceeds of the sale of any securities hereafter issued under the Second Liberty Bond Act, as now or hereafter in force, and the purposes for which securities may be issued under the Second Liberty Bond Act as now or hereafter in force, are extended to include such purchases. Each purchase of obligations by the Secretary of the Treasury under this subsection shall be upon such terms and conditions as to yield a return at a rate not less than a rate determined by the Secretary of the Treasury, taking into consideration the current average yield on outstanding marketable obligations of the United States of comparable maturities. The Secretary of the Treasury may sell, upon such terms and conditions and at such price or prices as he shall determine, any of the obligations acquired by him under this paragraph. All purchases and sales by the Secretary of the Treasury of such obligations under this paragraph shall be treated as public debt transactions of the United States.

(h) The Secretary of the Treasury is authorized and directed to make annual payments to the Authority in such amounts as are necessary to equal the amount by which the dollar amount of interest expense accrued by the Authority on account of its obligations exceeds the dollar amount of interest income accrued by the Authority on account of obligations purchased by it pursuant to subsection (e) of this section.

(i) The Authority shall have power—

(1) to sue and be sued, complain and defend, in its corporate name;

(2) to adopt, alter, and use a corporate seal, which shall be judicially noticed;

(3) to adopt, amend, and repeal bylaws, rules, and regulations as may be necessary for the conduct of its business;

(4) to conduct its business, carry on its operations, and have offices and exercise the powers granted by this section in any State without regard to any qualification or similar statute in any State;

(5) to lease, purchase, or otherwise acquire, own, hold, improve, use, or otherwise deal in and with any property, real, personal, or mixed, or any interest therein, wherever situated;

(6) to accept gifts or donations of services, or of property, real, personal, or mixed, tangible or intangible, in aid of any of the purposes of the Authority;

(7) to sell, convey, mortgage, pledge, lease, exchange, and otherwise dispose of its property and assets;

(8) to appoint such officers, attorneys, employees, and agents as may be required, to define their duties, to fix and to pay such compensation for their services as may be determined, subject to the civil service and classification laws, to require bonds for them and pay the premium thereof; and

(9) to enter into contracts, to execute instruments, to incur liabilities, and to do all things as are necessary or incidental to the proper management of its affairs and the proper conduct of its business.

(j) The Authority, its property, its franchise, capital, reserves, surplus, security holdings, and other funds, and its income shall be

exempt from all taxation now or hereafter imposed by the United States or by any State or local taxing authority; except that (A) any real property and any tangible personal property of the Authority shall be subject to Federal, State, and local taxation to the same extent according to its value as other such property is taxed, and (B) any and all obligations issued by the Authority shall be subject both as to principal and interest to Federal, State, and local taxation to the same extent as the obligations of private corporations are taxed.

(k) All obligations issued by the Authority shall be lawful investments, and may be accepted as security for all fiduciary, trust, and public funds, the investment or deposit of which shall be under authority or control of the United States or of any officer or officers thereof. All obligations issued by the Authority pursuant to this section shall be deemed to be exempt securities within the meaning of laws administered by the Securities and Exchange Commission, to the same extent as securities which are issued by the United States.

(l) In order to furnish obligations for delivery by the Authority, the Secretary of the Treasury is authorized to prepare such obligations in such form as the Authority may approve, such obligations when prepared to be held in the Treasury subject to delivery upon order by the Authority. The engraved plates, lithographic stones, and so forth, executed in connection therewith, shall remain in the custody of the Secretary of the Treasury. The Authority shall reimburse the Secretary of the Treasury for any expenditures made in the preparation, custody, and delivery of such obligations.

(m) The Authority shall, as soon as practicable after the end of each fiscal year, transmit to the President and the Congress an annual report of its operations and activities.

(n) The sixth sentence of the seventh paragraph of section 5136 of the Revised Statutes, as amended (12 U.S.C. 24), is amended by inserting "or obligations of the Environmental Financing Authority" immediately after "or obligations, participations, or other instruments of or issued by the Federal National Mortgage Association or the Government National Mortgage Association".

(o) The budget and audit provisions of the Government Corporation Control Act (31 U.S.C. 847) shall be applicable to the Environmental Financing Authority in the same manner as they are applied to the wholly owned Government corporations.

(p) Section 3689 of the Revised Statutes, as amended (31 U.S.C. 711), is further amended by adding a new paragraph following the last paragraph appropriating moneys for the purposes under the Treasury Department to read as follows:

"Payment to the Environmental Financing Authority: For payment to the Environmental Financing Authority under subsection (h) of the Environmental Financing Act of 1972."

SEX DISCRIMINATION

SEC. 15. No person in the United States shall on the ground of sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal assistance under this Act, the Federal Water Pollution Control Act, or the Environmental Financing Act. This section shall be enforced through agency provisions and rules similar to those already established, with respect to racial and other discrimination, under title VI of the Civil Rights Act of 1964. However, this remedy is not exclusive and will not prejudice or cut off any other legal remedies available to a discriminatee.

APPENDIX G

WATER QUALITY OBJECTIVES

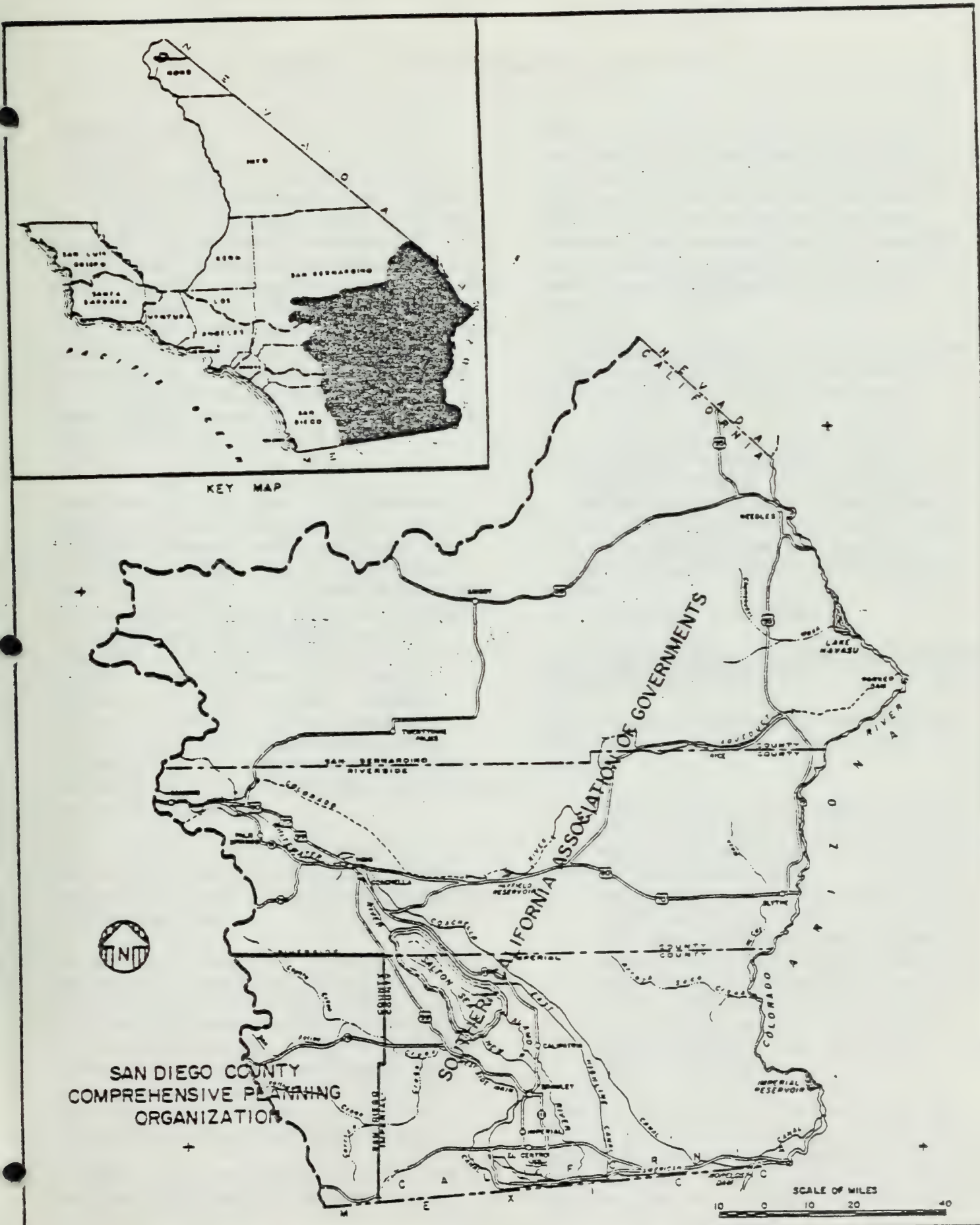
AND

PHYSICAL AND HYDROLOGIC CHARACTERISTICS

WATER QUALITY CONTROL PLAN
WEST COLORADO RIVER BASIN (7A)

April 1975

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
COLORADO RIVER BASIN REGION



EAST AND WEST COLORADO RIVER BASINS
Regional Planning Areas
Figure 9–1

CHAPTER 4. WATER QUALITY OBJECTIVES

INTRODUCTION

Section 13241, Division 7 of the California Water Code specifies that each Regional Water Quality Control Board shall establish such water quality objectives in water quality control plans which, in the Regional Board's judgment, will ensure the reasonable protection of beneficial uses and the prevention of nuisance. Chapter 2 of this Plan enumerates the beneficial uses of waters in the West Colorado River Basin (7A).

Section 303 of the 1972 Amendments to the Federal Water Pollution Control Act requires the State to submit to the Administrator of the U. S. Environmental Protection Agency for his approval, all new or revised water quality standards which are established for surface and ocean waters. Under federal terminology, water quality standards consist of the beneficial uses enumerated in Chapter 2 and the water quality objectives contained in this chapter.

The water quality objectives contained herein are designed to satisfy all state and federal requirements.

As new information becomes available, the Regional Board will review the appropriateness of the objectives contained herein. These objectives will be subject to public hearing at least once during each three-year period for the purpose of review and modification as appropriate.

"Water quality objectives", as defined in the Porter-Cologne Water Quality Control Act and as used in this Plan are "limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specified area".

The overall water quality objective is to maintain the better of two levels of water quality:

1. That quality required to maintain beneficial uses, as recommended by the National Technical Advisory Committee on Water Quality Criteria, the U. S. Public Health Service, and certain other authorities, or
2. Existing quality.

CONSIDERATIONS IN SELECTING WATER QUALITY OBJECTIVES

The general intent in establishing water quality objectives is that:

1. Where levels of chemical constituents are equal to or exceed the criteria, the quality be improved; and
2. Where levels of chemical constituents are equal to or below the recommended criteria, numerical limits be established to maintain the existing quality, except where a change is consistent with, exceptions stated under the Nondegradation Policy.

The water quality objectives set forth in this Plan are those necessary to protect present and probable future beneficial uses within the Basin. These water quality

objectives are implemented through the establishment of waste discharge requirements by the Regional Board, and by other control measures recommended in the Plan.

The beneficial uses and water quality objectives set forth in this Plan apply to general areas. The Regional Board, in setting waste discharge requirements, will consider the particular impact on beneficial uses within the immediate area of influence of the discharge, the existing quality of receiving waters, and water quality objectives. This consideration includes: (1) a specific enumeration of the beneficial uses potentially to be affected by the waste discharge, (2) impact of the discharge on existing beneficial uses, (3) receiving water quality, and (4) water quality objectives. The Regional Board will make a finding as to the beneficial uses within the area of influence of the discharge and set waste discharge requirements to protect these uses while not allowing the discharge to violate receiving water objectives.

EXISTING STATEWIDE PLANS AND POLICIES

The State Water Resources Control Board has adopted a "Statement of Policy with Respect to Maintaining High Quality of Waters in California", and the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California". The Regional Board is required to implement the provisions of these plans and policies.

Nondegradation Policy

On October 28, 1968, the State Water Resources Control Board adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California". While requiring the continued maintenance of existing high quality waters, the policy provides conditions under which a change in water quality is allowable. A change must:

- be consistent with maximum benefit to the people of the State,
- not unreasonably affect present and anticipated beneficial uses of water, and
- not result in water quality less than that prescribed in water quality control plans or policies.

Thermal Plan

The "Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California", adopted by the State Water Resources Control Board on May 18, 1972, specifies water quality objectives, effluent quality limits, and discharge prohibitions related to thermal characteristics of interstate waters and waste discharges.

WATER QUALITY OBJECTIVES

The water quality objectives which follow, supersede, and replace those contained in the 1967 Water Quality Control Poli-

cy for Interstate Waters, the Interim Water Quality Control Plan for the West Colorado River Basin, June 1971 and its revisions adopted in December 1972 and in February 1975.

Controllable water quality factors shall conform to the water quality objectives contained herein. When other factors result in the degradation of water quality beyond the levels or limits established herein as water quality objectives, the controllable factors shall not cause further degradation of water quality.

Controllable water quality factors are those actions, conditions, or circumstances resulting from people's activities which may influence the quality of the waters of the State and which may feasibly be controlled in consideration of existing topographic rearrangements.

General Objectives

The following objective shall apply to all waters of the Basin.

Nondegradation

Wherever the existing quality of water is better than the quality established herein as objectives, such existing quality shall be maintained unless otherwise provided by the provisions of the State Water Resources Control Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California", including any revisions thereto. A copy of this Policy is included verbatim in the special appendix to Part I entitled "Plans and Policies".

OBJECTIVES FOR SURFACE WATERS

The following objectives are to be maintained in all surface waters of the West Colorado River Basin (7A).

Color

Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.

Tastes and Odors

Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance or adversely affect beneficial uses.

Floating Material

Waters shall not contain floating material, including solids, liquids, foams, and scum in concentrations that cause nuisance or adversely affect beneficial uses.

Suspended Material

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

Settleable Material

Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.

Oil and Grease

Waters shall not contain oil, grease, wax or other materials in concentrations that result in a visible film or coating on the surface of the water, that cause nuisance, or that otherwise adversely affect beneficial uses.

Biostimulatory Substances

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.

In addition, waste discharges shall not cause total nitrate (NO_3) and/or total phosphate (PO_4) concentrations to exceed the following levels:

Constituent	Annual Average (mg/l)	90 Percentile (mg/l)
Total Nitrate (NO_3)	5.0	7.0
Total Phosphate (PO_4)	0.05	0.10

This objective shall apply to all surface waters of the basin, excluding New River, Alamo River, Coachella Valley Stormwater Channel and Irrigation Drains.[1] However, nitrate and phosphate limitations will be placed on industrial discharges to the above-excluded water on a case-by-case basis, taking into consideration the primary beneficial use of these streams.

Sediment

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

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[1]The source water of Alamo River, New River, Coachella Valley Stormwater Channel and other irrigation drains is supplied predominantly from the use of these channels as collectors and transporters of control and drainage (including subsurface) waters from irrigated lands in Imperial and Coachella Valleys, in order to maintain adequate soil-salinity balance for agriculture in these Valleys. This is their primary beneficial use; and this use does not unreasonably affect the quality of the usable waters of the State. Alamo River and New River also receive control and surface drainage water from irrigated lands in Mexicali Valley.

The object is to protect the quality of this "source water" from degradation by unreasonable impairment by other industrial wastes, or by sewage. The term "other industrial wastes" as used hereafter means all industrial wastes other than industrial wastes consisting of "control and drainage (including subsurface) waters from irrigated lands in the Imperial Valley".

Executive Order of Withdrawal (Public Water Reserve No. 114, California No. 26), signed by the President February 26, 1928, withdrew from all forms of entry all public lands of the United States in the Salton Sea area lying below the elevation of -220 feet for the purpose of creating a reservoir in Salton Sea for storage of wastes and seepage water from irrigated land in the Imperial Valley.

Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

1. Where natural turbidity is between 0 and 50 JTU, increases shall not exceed 20 percent.

2. Where natural turbidity is between 50 and 100 JTU, increases shall not exceed 10 JTU.

3. Where natural turbidity is greater than 100 JTU, increases shall not exceed 10 percent.

pH

Changes in normal ambient pH levels attributable to controllable water quality factors shall not exceed 0.5 units; and shall not depress the receiving water pH below 6.5 units nor raise it above 8.5 units.

Dissolved Oxygen

As a result of controllable water quality factors, the dissolved oxygen concentration shall not be reduced below the following minimum levels at any time:

Waters designated
WARM or SAL ..... 5.0 mg/l
Waters designated
COLD ..... 7.0 mg/l

When natural factors cause lesser concentrations, controllable water quality factors shall not cause further reduction.

Bacteria

In waters designated for contact recreation (REC 1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100 ml, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 ml. These bacteriological values are to be used as maximum allowables for the purpose of upgrading the bacteriological quality of those REC 1 waters whose fecal coliform levels are generally in excess of the above as of the effective date of this Plan. Existing fecal coliform levels shall be maintained or shall be lowered where feasible, in those REC 1 waters whose existing fecal coliform levels are generally below the above listed levels as of the effective date of this Plan.

In waters designated for noncontact recreation (REC 2) and not designated for contact recreation (REC 1), the average fecal coliform concentration for any 30-day period shall not exceed 2000/100 ml nor shall more than ten percent of samples collected during any 30-day period exceed 4000/100 ml.

Temperature

Temperature objectives for WARM interstate waters are as specified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" including any revisions thereto. A copy of said plan is included verbatim in the special appendix to Part I entitled "Plans and Policies". Irrigation return water is not considered elevated temperature waste for the purpose of this plan.

Waste discharges shall not cause the temperature of WARM interstate waters to be increased by more than 5°F.

The natural receiving water temperature of intrastate waters shall not be altered by waste discharges unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses. Receiving water temperature shall not under any circumstances be increased by more than 5°F above natural levels as a result of controllable water quality factors.

Toxicity

Waters of the State shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in human, plant, animal, or indigenous aquatic life, or which create undesirable tastes or odors in organisms utilized for human consumption. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration or other appropriate methods as specified by the Regional Board. The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or other control water which is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater, 13th Edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour bioassay. In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.

Ammonia

The discharge of wastes shall not cause concentrations of un-ionized ammonia (NH_3) to exceed 0.025 mg/l as nitrogen (N) in receiving waters, provided however that:

1. Limitations on waste discharges from existing industrial sources for which the Administrator of the EPA has promulgated national standards of performance under Section 306 of the FWPCA Amendments of 1972 shall be in accordance with said standards, unless, in a specific case, the Regional Board specified limitations which are more strict than said standards.

2. Limitations on agricultural discharges into New River, Alamo River, Coachella Valley Stormwater Channel, and irrigation drains, shall not apply until such time as waste discharge requirements for agricultural discharges specify quantitative values.

Pesticides

No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.

The summation of concentrations of total identifiable pesticides (including herbicides) in the following waters shall not exceed the following levels:

Water*	Annual Average Value mg/l	Maximum Value mg/l
Imperial and Coachella Valley Irrigation Drains and the New River, Alamo River, Coachella Valley Stormwater Channel and Salton Sea	0.002	0.004
All other waters	—	0.0001

*Exception is allowed for: (1) herbicides in those irrigation canals that are not used for domestic purposes and where short-term application operations are conducted under irrigation district supervision in coordination with the State Department of Fish and Game; and (2) pesticides from strictly farming origin.

Chemical Constituents

Water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the limits specified in California Administrative Code, Title 17, Chapter 5, Subchapter 1, Group 1, Article 4, Section 7019, Tables 4-1, 4-2, and 4-3 as listed below; or as may subsequently be revised in said Title 17.

TABLE 4-1
LIMITING CONCENTRATIONS
INORGANIC CHEMICALS

Constituent	Limiting Concentration (mg/l)
Arsenic (As)	0.10
Barium (Ba)	1.0
Cadmium (Cd)	0.01
Chromium (Cr)	0.05
Cyanide (CN)	0.2
Lead (Pb)	0.05
Mercury (Hg)	0.005
Nitrate-N + Nitrite-N	10
Selenium (Se)	0.01

TABLE 4-2
LIMITING CONCENTRATIONS
FLUORIDE CONCENTRATION

Annual Average of Maximum Daily Air Temperatures	Fluoride Concentration, mg/l		
	Lower	Optimum	Upper
50-54	0.9	1.2	1.7
55-58	0.8	1.1	1.5
59-64	0.8	1.0	1.3
65-71	0.7	0.9	1.2
72-79	0.7	0.8	1.0
80-81	0.6	0.7	0.8

TABLE 4-3
LIMITING CONCENTRATIONS
ORGANIC CHEMICALS

Constituent	Limiting Concentration, mg/l	
Carbon-Alcohol extract (CAE-m)	3.0	
Carbon-Chloroform extract (CCE-m)	0.7	
Foaming agent (MBAS)	0.5	
Pesticides:		
Aldrin	0.017	
Chlordane	0.003	
DDT	0.042	
Dieldrin	0.017	
Endrin	0.001	
Heptachlor	0.018	
Heptachlor epoxide	0.018	
Lindane	0.056	
Methoxychlor	1.0	
Organophosphorous and Carbamate compounds	0.1	As parathion in cholinesterase inhibition
Toxaphene	0.005	
Herbicides:		
2, 4-D plus 2, 4, 5-T plus 2, 4, 5-TP	0.1	

To the extent that these limits conflict with other objectives stated in this Plan, the more stringent objective shall apply.

Waters designated for use as agricultural supply (AGR) shall not contain concentrations of chemical constituents in amounts which adversely affect such beneficial use.

The discharge of wastes shall not cause concentrations of Boron to exceed 0.50 mg/l in surface waters designated AGR.

The discharge of wastes shall not cause concentrations of constituents to exceed the following limits (Table 4-4) in surface receiving waters. Where natural levels already meet or exceed these levels, no further increases from controllable sources are allowed.

TABLE 4-4
LIMITING CONCENTRATIONS OF CHEMICALS
IN DISCHARGES OF WASTES TO SURFACE WATERS

Constituent	Limiting Concentration (mg/l) 90th Percentile	Maximum
Aluminum (Al)	0.10	0.11
Arsenic (As)	0.05	0.06
Barium (Ba)	0.50	0.55
Cadmium (Cd)	0.01	0.01
Chromium (Total Cr)	0.05	0.06
Copper (Cu)	0.05	0.06
Cyanide (CN)	0.005	0.01
Iron (Fe)	0.20	0.22
Lead (Pb)	0.05	0.06
Manganese (Mn)	0.05	0.06
Selenium (Se)	0.01	0.01
Silver (Ag)	0.01	0.01
Zinc (Zn)	0.05	0.06
Mercury (Hg)	0.005	0.01
MBAS	0.20	0.22

Dissolved solids shall not be added in quantities found to be deleterious to established beneficial uses.

The Chlorine (Cl_2) limitations shall be as follows:

Surface Water	Chlorine (Cl_2) Limitation (mg/l) 90th Percentile	Maximum
1. All water capable of supporting coldwater fish populations	.002*	.003*
2. New River, Alamo River, C.V. Storm Drain, and irrigation drains	0.5	1.0
3. Waters not included in Nos. 1 and 2 above	0.1	0.20

*The State Department of Health laboratory personnel advise that the sensitivity of field chlorine determinations at low levels is limited. The iodometric titration method is not accurate at less than 0.2 mg/l, and a battery-operated amperometric titrator is not accurate at less than 0.1 mg/l chlorine. It is not the intent of the Regional Board to require other than normal field methods for chlorine determination.

The discharge of wastes, excepting discharges from agricultural sources, shall not cause the concentration of total dissolved solids (TDS) to exceed the following limits:

	TDS (mg/l)	
	Annual Average	Maximum
New River	4000	4500
Alamo River	4000	4500
Imperial Valley Irrigation Drains	4000	4500
Coachella Valley Irrigation Drains	2000	2500

Salton Sea

The present salinity of the Salton Sea is about 38,000 mg/l. In order to protect the beneficial uses of the Sea, the water quality objective is to reduce the average salinity to about 35,000 mg/l. This objective cannot be achieved without a salinity control project. Until a salinity control project is implemented, the objective is to limit the rate of increase of total dissolved solids of the Salton Sea to the lowest possible value, consistent with its primary purpose as a reservoir to receive and store agricultural drainage and seepage water.

Radioactivity

Radionuclides shall not be present in waters in concentrations which are deleterious to human, plant, animal or aquatic life nor that result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal, or aquatic life.

Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the limits specified in California Administrative Code, Title 17, Chapter 5, Subchapter 1, Group 1, Article 4, Section 7019, as listed below.

LIMITING CONCENTRATIONS
RADIOACTIVITY

Gross Beta	1,000 pc/l
Radium -226 . . .	3 pc/l
Strontium-90 . . .	10 pc/l

Diverted Colorado River Waters

Specific numerical limits cannot be set on salinity levels of these waters until salinity standards and the implementation plans are established for the water in Colorado River. However, these diverted waters are captured for specific uses, and the controlling agencies do not allow any waste discharges into the diverted waters.

OBJECTIVES FOR GROUNDWATERS

The following objectives are to be maintained in applicable groundwaters of the West Colorado River Basin (7A).

Tastes and Odors

Groundwaters shall not contain taste or odor-producing substances in concentrations that adversely affect beneficial uses.

Bacteria

In groundwaters designated for use as domestic or municipal supply (MUN) the concentration of coliform organisms over any 7-day period shall not exceed a median of 2.2/100 ml.

Chemical Constituents

Groundwaters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the limits specified in California Administrative Code, Title 17, Chapter 5, Subchapter 1, Group 1, Article 4, Section 7019, Tables 4-1, 4-2, and 4-3.

Groundwaters designated for use as agricultural supply (AGR) shall not contain concentrations of chemical constituents in amounts that adversely affect such beneficial use.

The discharge of wastes shall not cause concentrations of Boron to exceed 0.50 mg/l in groundwaters designated AGR.

Radioactivity

Groundwaters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the limits specified in California Administrative Code, Title 17, Chapter 5, Subchapter 1, Group 1, Article 4, Section 7019, listed above.

Specific Objectives

Records of groundwater quality on file in the Department of Water Resources dating from 1900 to 1971 were reviewed (although 90 percent of the available data were obtained after 1951), to determine those areas of the West Colorado River Basin for which sufficient data are available to constitute a valid statistical base for establishment of numerical objectives or limits of chemical constituents. Sufficient data on groundwater quality were available for some units or subunits in the Basin. Until sufficient data become available to more definitely establish groundwater quality, the values in Table 4-5 will be used as areawide water quality objectives for groundwater within the designated units of the Basin.

From a practical standpoint, existing water quality cannot be maintained in this Basin because optimization of water resources requires reuse and/or infiltration of reclaimable water to maintain the water supply and the area's economy. However, this does not alter the soundness of setting existing quality as the objective in those areas which have usable groundwaters, because:

1. The groundwater basins are large. The very small amounts of municipal and industrial wastewater that will reach the groundwater should not measurably change the overall groundwater quality within the planning period. A small amount of degradation, however, may occur in local areas, but this degradation must be tolerated in this water-short area. Therefore, flexibility must be built into any numerical objective established for a specific area.

2. Agricultural return flows are not infiltrated in large quantities to groundwater basins that have high quality water.

The objective of maintaining existing water quality does not apply to either the groundwater underlying the agricultural land in the Imperial Valley or the perched groundwater above the clay cap in the lower Coachella

Valley, because these waters are already too brackish to be used for municipal, industrial, or agricultural purposes, and because there are no other practical means for disposal of agricultural wastewaters.

Existing groundwater quality in the Basin is further described in Chapter 14, which also contains maps that show the range of TDS in groundwater of the Basin. In addition, tabulations of groundwater quality data for individual wells, and also the average quality for wells within any specific township, range, and section, are on file in the office of the Regional Board. The maps, which indicate areal variations in quality plus data on individual wells, provide valuable information concerning the quality of groundwater for specific locations. These three water quality indicators, i.e., values in Table 4-5, water quality maps in Chapter 14, and well data, when used conjunctively will provide a guide in setting waste discharge requirements, and in taking other control measures to achieve areawide water quality objectives.

The objectives contained in Table 4-5 may be modified as additional data become available, particularly as developed by the surveillance and monitoring program described in Chapter 7 and Appendix D. For those parts of the Basin for which data are insufficient to establish numerical objectives, the policy will be to maintain existing water quality until numerical objectives can be established.

TABLE 4-5

SELECTED CHEMICAL WATER QUALITY OBJECTIVES
FOR GROUNDWATER - WEST COLORADO RIVER BASIN

Hydrologic Subdivision	*Concentration in mg/l					
	SO_4	Cl	NO_3	F	B	TDS
COACHELLA VALLEY PLANNING AREA						
Indio subarea						
Palm Springs and Vicinity	50 / 75	20 / 25	5.0 / 12	0.4 / 0.7	.04 / .10	250 / 350
Thousand Palms and Vicinity	30 / 50	15 / 20	2.5 / 8.0	.8 / 2.0	.02 / .40	250 / 350
Palm Desert and Vicinity	50 / 100	25 / 60	2.5 / 20	.3 / .4	.10 / .25	275 / 400
Indio and Vicinity	15 / 70	10 / 50	1.0 / 2.4	.5 / 0.9	.09 / .10	200 / 290
Remaining areas in the Indio subarea	100 / 300	35 / 150	2.5 / 13	1.0 / 5.0	.10 / .50	250 / 950
ANZA BORREGO PLANNING AREA						
Borrego subarea	330 / 750	100 / 250	20 / 100	0.6 / 0.9	.10 / .35	840 / 1750
LUCERNE PLANNING AREA						
Lucerne unit	106 / 345	40 / 164	3.2 / 14	0.6 / 1.6	.08 / .55	395 / 820
Twentynine Palms Subunit	75 / 450	55 / 85	5.0 / 11	7.0 / 12	.30 / .50	390 / 765

*Annual
Average value
/ 90th percentile value

CHAPTER 9. POLICIES AND GUIDELINES

INTRODUCTION

Federal and state laws have been enacted which establish the requirements for planning implementation, management, and enforcement, including penalties for noncompliance, for the control of water quality. In addition, federal "regulations" and state "regulations" and "plans" have been developed to augment and clarify the laws and to provide detail not included in the laws. The public is offered the opportunity to comment upon proposed regulations and plans before the appropriate governmental body. Federal "guidelines" and state "policies" on the other hand, express the intent of the governing body. While these are not legally enforceable, they establish mandatory constraints on the basin plans and otherwise set forth firm direction that should be followed to achieve the goals expressed in the laws. Guidelines are more often associated with the idea of standards or limiting values which express further the details of conformance required by, or implied in, the laws, regulations, plans, and policies. These documents are concerned with implementation of the intent of the law.

In addition to the above, the State Board developed a series of more than 25 "Management memoranda". These provided detailed planning criteria for the development of basin plans.

This basin plan has been prepared in compliance with applicable federal and state laws, regulations, plans, policies and guidelines in force in 1974. To the extent required in recognition of this plan as an official document, the complete text of the laws, regulations, plans, policies, and guidelines summarized below are hereby included in this plan by reference.

FEDERAL REQUIREMENTS

Laws

One federal law specifically and directly addresses the matter of water pollution control. This law, known as the Federal Water Pollution Control Act, Public Law 92-500, was passed by the Congress on October 18, 1972. Several other federal laws, classifiable as "environmental" laws, also bear upon the planning program. Chief among these is the National Environmental Policy Act, Public Law 91-190, approved January 1, 1970. Emphasis is given to these two laws in subsequent sections. Another of the environmental laws which has an impact upon the program to some extent is the Clean Air Act, Public Law 91-604. The impact of this law is described briefly.

Federal Water Pollution Control Act

The objective of the act is to restore and preserve the integrity of the nation's waters. Six goals set forth to achieve this objective are (1) to eliminate the discharge of pollutants to navigable waters by 1985; (2) to provide water quality which protects and fosters propagation of fish, shellfish,

and wildlife and allows recreation in and on the water by 1983; (3) to prohibit discharge of toxic pollutants in toxic amounts; (4) to provide financial assistance to construct publicly owned treatment systems; (5) to develop and implement areawide waste treatment management plans; and (6) to develop the technology necessary to carry out these goals. It is the policy of Congress to recognize the rights of the states to prevent and eliminate pollution and to plan the development and use of land and water resources. It is also the desire of the Congress to encourage full public participation in the development and/or revision of any regulations, plans, and programs. The responsibility to administer the act is placed with the Administrator of the Environmental Protection Agency (EPA).

The 1972 amendments to the act are set forth in five parts or titles, applicable portions of which are summarized below. When used in the act, and in the summary below, the words "pollution" and "pollutant" are defined as follows:

(a) "pollution" means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water; and (b) "pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Title I, Research and Related Programs. The goals and policies of the act described above are contained in Title I. In addition, the law requires the Administrator to develop, in cooperation with federal, state, and local agencies, and industries, comprehensive programs for preventing, reducing, or eliminating pollution and improving the quality of the nation's waters.

These programs must set forth the actions necessary to conserve the waters for the protection and propagation of aquatic life and wildlife, recreation, and public, agricultural, and industrial water supply. Grant monies are offered to cover up to 50 percent of the administrative expenses for a period not to exceed 3 years to any capable planning agency engaged in development of such a program. To receive such a grant, the plan must (a) be consistent with established quality standards, effluent limitations, and discharge regulations, (b) recommend the most effective and economical system for collection, treatment, and elimination of pollutants, (c) recommend maintenance and improvement of water quality and adequate financing to implement the plan, and (d) be consistent with any areawide plan developed pursuant to Sections 208 and 303 (e) of the act.

Additional grant fund limitations are imposed (Sec. 106e) beginning in 1974 in that any State receiving funds must

establish an acceptable surveillance and monitoring system for gathering, analyzing, and reporting water quality data, and possess emergency power to immediately restrain any discharge of pollutants which imminently and substantially endanger the health and, if their livelihood is threatened, the welfare of the people.

Title II, Grants for Construction of Treatment Works. The purpose of this title is to provide the means to develop and implement the waste treatment management plans. Implementation is to be effected by application of the best practicable waste treatment technology before discharge, including reclaiming and recycling, and confined disposal of pollutants (Sec. 201 a and b). Planners must consider (a) areawide or regional control of point and non-point sources, (b) construction of revenue-producing facilities, (c) integration of municipal and industrial treatment and recycling systems, and (d) plans which combine open space and recreational opportunities with waste treatment management (Section 201 c-f). Grant funds are offered to any state, interstate, or local agency for the construction of publicly-owned treatment works (Sec. 201g) in the amount of 75 percent of the cost of construction (Sec. 202a).

Limitations on grants are (a) the facilities must include any applicable areawide waste treatment management plan under Section 208, (b) the facilities must conform to any applicable state plan under Section 303e, (c) the facilities must enjoy certified priority in accordance with the state plan under Section 303e and (d) the applicant agrees to pay nonfederal costs and maintain and operate the facility (Sec. 204a). Further grants will not be approved unless the applicant has adopted a system of user charges, has provided for repayment by industry of its share of construction costs, and has the legal, institutional, managerial, and financial capability to construct and operate the facility (Sec. 204b(1)). Section 204b(3) describes how industry repayment will be handled.

To encourage and facilitate areawide waste treatment management planning, the act provides for the designation by the State of areawide planning agencies (Section 208a) and areawide management agencies (208c). The State must act as the planning agency for areas not so designated. Planning agencies are given 1 year to have in operation a continuing areawide waste treatment planning process consistent with Section 201. Requirements of the plan prepared under this process are detailed in the act (Sec. 208b(2)). The State must similarly designate the areawide waste treatment management agencies which must implement the areawide plan. Management agencies must have the capability and authority to design, construct, and maintain facilities; raise revenues; incur indebtedness; establish user charges; prepare and enforce use ordinances; and accept industrial wastes for treatment. Grant funds are available for the planning agency operations.

Title III, Standards and Enforcement. This title sets forth the standards for discharge of wastewaters (Sec. 301),

provides for establishment and federal approval of water quality standards (Sec. 303a), requires each state to classify and rank its surface waters as to severity of pollution (Sec. 303d), and requires each state to develop a statewide planning process (Sec. 303e).

The effluent limitations established (Sec. 301) are tabulated below.

More stringent limitations (including elimination of discharges) necessary to meet water quality standards, treatment standards, or discharge requirements are to be established by July 1, 1977 (Sec. 301B(1) and Sec. 302a). Discharge of radiological, chemical, and biological warfare agents and high-level radioactive wastes is prohibited (Sec. 301f). The act requires the establishment of water quality objectives (standards in the language of the law) for all waters of the State (Sec. 303a), with a requirement to review these objectives periodically (Sec. 303c). States are required to compare the established objectives with the expected decrease in pollution upon application of the effluent limitations. They are also required to identify water segments where the objective, including thermal objectives, will not be attained and establish a priority ranking for all such waters based upon severity of pollution and established beneficial uses (Sec. 303d). The states are also required to compute the total maximum daily load for those pollutants that cause effluent limitation levels of treatment to fall short of quality objectives. These computations are to allow for seasonal variations and a margin of safety for inadequate knowledge of the relevant factors (Sec. 303d).

Each State shall develop and implement a continuing water quality planning process (Sec. 303e). The process must include (a) schedules of compliance with effluent limitations, (b) applicable areawide plans prepared under Section 208, (c) total maximum daily loads of pollutants for water quality class segments, (d) procedures for plan revisions, (e) authority for intergovenmental cooperation, (f) provisions for adequate implementation of the plan, (g) controls for disposition of water processing residual streams,

Effluent Limitations - Point Sources

	By July 1, 1977	By July 1, 1983
Other Than Publicly Owned Treatment Works	Best practicable control technology currently available	Best available technology economically achievable
Publicly Owned Treatment Works	Secondary treatment	Best practicable waste treatment technology

and (h) an inventory and ranking in order of priority of facility needs.

Under Section 306, the law requires that after the effective date of the adoption thereof, any new source of waste discharge must operate without violation of any applicable standard of performance. A new source is one constructed after adoption of the standards of performance. The standards of performance, which are being developed by EPA, are effluent limitations to be placed on the discharges from new industrial sources. The states must develop an enforcement procedure. For the case where discharge is made to a publicly owned treatment works, pretreatment requirements are to be established for those pollutants not susceptible to treatment or which would interfere with the operation of such treatment works (Sec. 307b).

With regard to thermal discharges only, the law provides that less stringent effluent limitations can be set forth where the discharger can demonstrate, after a public hearing, that adverse effects to fish, aquatic life and wildlife are not caused by the discharge (Sec. 316a). Standards for point source discharges shall require the design of cooling water intakes to reflect the best technology available for minimizing adverse environmental impact (Sec. 316b).

Title IV, Permits and Licenses. Title IV establishes the permit system which controls discharges to navigable waters. The law (Sec. 401) requires a license or permit for any discharge into a navigable water body. The permit must set forth any effluent limitations, including prohibitions, and monitoring requirements necessary to assure compliance with applicable effluent limitations of Sections 301 or 302; standards of performance of Section 306; any prohibition, effluent standard, or pretreatment requirement of Section 307; or any appropriate state requirement. States having a permit procedure acceptable to EPA may be given responsibility to handle the permit program. In any case where disposal of sewage sludge would result in any pollutant therefrom entering navigable waters, such disposal is prohibited except in accordance with a permit issued (Sec. 405a).

Title V, General Provisions. Except for the definitions contained in Section 502, this title does not impose any requirements pertaining to the basin planning program.

National Environmental Policy Act of 1969 (NEPA)

In general, the Act proposes to preserve the acceptable environments and to restore those that have been degraded. The method that has been devised to accomplish this is to force the evaluation of the effect of each action on the environment and to consider the result in making decisions regarding the action. The lead in this method was provided by NEPA, which applies only to the actions of the Federal Government. However, the idea and methods of NEPA have been accepted by many state and local governments to the extent that even private actions under local regulations must now submit to assessment of their effects on the environment.

NEPA declares a continuing policy for all levels of government and concerned public and private organizations to create and maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations. The act directs an interdisciplinary approach to insure integrated use of all talents in planning and decision making that has an impact on the environment (Sec. 102). Every report or recommendation must be accompanied by a detailed statement by the responsible official on (a) the environmental impact of the proposed action, (b) any adverse environmental effects which cannot be avoided if the action is taken, (c) alternatives to the proposed action, (d) relationship between local short-term uses of the environment and maintenance and enhancement of long-term productivity, and (e) any irreversible and irretrievable commitments of resources if the proposed action is taken. Appropriate alternatives to proposed actions must be studied and developed when conflicts in use of available resources are encountered.

The Clean Air Act

The present federal air pollution legislation is known as the Clean Air Amendments of 1970, Public Law 91-604 (December 31, 1970). The act is a comprehensive piece of legislation establishing air quality control regions, standards, and research grants and requiring the states to develop and implement an air quality control plan. It provides for federal approval of the state's plan and federal enforcement of the plan in case the EPA Administrator finds that the state is failing to enforce it.

The impact of the Clean Air Act on the water quality control plans is felt indirectly in those areas designated "air critical", wherein the air quality is below standard. Air quality is directly related to population, and attempts are being made to control population growth in air critical areas by limiting the extension of the urban infrastructure, i.e., wastewater collection and treatment and other facilities. This is being carried out through the Clean Water Grants Program of the State of California as described later in this chapter.

Noise Control Act

The Federal Noise Control Act of 1972, Public Law 92-574, is companion legislation to the water and air related acts and treats the problems of noise emissions. This law establishes standards and enforcement provisions and places the primary responsibility for noise control on the state and local governments. The Act impacts water quality control plans by requiring consideration of noise levels in the location of wastewater treatment facilities.

Regulations

Federal Water Pollution Control Act

In a listing of regulations specifically mentioned in the act or interpreted to be required by the act during its first year, there were 38 different regulations set forth.

Many of these regulations have not yet appeared, some have been issued in draft form, and only a few have been published in final form. About half of these regulations apply to the basin planning program.

The regulations which have been issued, in one state or another of finality, and which pertain to the planning program are listed below:

Section	Title
101e	Regulation for Minimum Guidelines for Public Participation in Planning Process (40 CFR 105)
106e	Regulations for Monitoring of Quality of Water (40 CFR 35, Appendix A)
201	Regulations for Grants for Facilities Construction (40 CFR 35)
201g(4)	Regulations for Grants for Sewer System Evaluation (40 CFR 35)
208a	Regulations for Areawide Waste Treatment Management Planning Agencies (40 CFR 126)
304d	Secondary Treatment Information (40 CFR 133)
307b(1)	Pretreatment Standards (40 CFR 128)

The present planning process generally conforms to the requirements of these regulations. Other regulations to be promulgated after near-completion of the basin plan will not necessarily have an effect on the plan.

National Environmental Policy Act

Regulations setting forth "Procedures for Preparation of Environmental Impact Statements" have been published in the Federal Register (40 CFR 6).

Guidelines

Federal Water Pollution Control Act

The status of guidelines needed for implementation of the act is similar to that of its associated regulations in that many have not yet appeared. A detailed analysis of the act shows 19 guidelines are required. Those guidelines which have been issued in one state of finality or another, and which pertain to the planning program, are listed below:

Section	Title
212c(2)	Cost-Effectiveness Analysis Guidelines (40 CFR 35)
303a	Developing or Revising Water Quality Standards
303e	Water Quality Management Basin Plans (40 CFR 130, 131)
304d	Effluent Reduction by Secondary Treatment
307a(1)	Proposed List of Toxic Pollutants (40 CFR 129)
404b	Dredged or Fill Material

The present planning program generally conforms to the limitations expressed in these guidelines but may not conform to guidelines issued later.

National Environmental Policy Act

The Council of Environmental Quality on April 23, 1971, issued "Guidelines for Federal Agencies under the National Environmental Policy Act" for preparing detailed environmental statements on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. The EPA issued "Environmental Assessments for Effective Water Quality Management Planning" to give guidance to planners responsible for preparing environmental assessments in basin, metropolitan, and regional water quality management plans. The basin planners have been encouraged by EPA, Region IX, to prepare their environmental assessments in accordance with this document.

STATE REQUIREMENTS

Laws

The laws in California are organized into the Constitution and 28 Codes encompassing all facets of the State's governmental controls. Laws having an effect on water resources planning are contained principally in the Water Code and to a lesser extent in the Administrative, Health and Safety, Public Resources, and Fish and Game Codes. Similar to the federal law, one state law is concerned primarily with the control of water quality. This law, known as the Porter-Cologne Water Quality Control Act, was enacted in 1969, and became Division 7 of the Water Code, starting with Section 13000 of that Code. The portions of the act relating to or governing the preparation of basin plans are summarized below.

Porter-Cologne Water Quality Control Act

The basic tenor of the act was set by a policy that the waters of the State shall be protected for use and enjoyment by the people of the State; that activities and factors which may affect the quality of the waters of the State shall be regulated to attain the highest water quality which is reasonable, considering all demands being made or to be made and the total values involved, beneficial and detrimental, economic and social, tangible and intangible; that the health, safety, and welfare of the people requires that there be a statewide program for control of the quality of all waters of the State and that quality and quantity of water shall be administered conjunctively. Further the statewide program for water quality control can most effectively be administered regionally within a framework of statewide coordination and policy. The State Board and nine regional boards are established as the principal state agencies with primary responsibility for control of water quality.

The State Board is responsible for the formulation and adoption of state policy for water quality control. State policy shall become a part of the California Water Plan. State policy shall consist of (a) water quality principles and guidelines for long-range planning of groundwaters and surface waters and the use of reclaimed water, (b) water quality objectives at key locations, and (c) other principles and guidelines deemed essential for water quality control.

The State Board may adopt water quality control plans for waters for which water quality standards are required by the Federal Water Pollution Control Act. These plans, when adopted, supersede any regional water quality control plans for the same waters to the extent of any conflict.

Each regional board must formulate and adopt, for its region, water quality control plans which establish such water quality objectives as in its judgment will ensure reasonable protection of beneficial uses and the prevention of nuisance. Factors to be considered in selecting objectives are: (a) past, present, and probable future beneficial uses, (b) environmental characteristics of the area, including quality of water supply, (c) water quality that could reasonably be achieved, and (d) economic considerations. The program for implementation of the plan shall include a description of the actions needed, a time schedule, and a plan for determining compliance. The plan adoption must follow public hearing on the plan. The plan may specify certain conditions or areas where discharge of waste or certain constitutents will not be permitted.

The act also sets forth the regulations for waste discharge requirements. Any person who is discharging, or proposes to discharge waste that could affect the quality of water, other than to a community sewer, shall file a report with the regional board containing information required by the board. After public hearing, the board will impose waste discharge requirements to govern the quality and quantity of the discharge. These discharge requirements may be reviewed and revised upon application by any affected person or by the board on its own motion. The discharge of wastes creates no vested right to continue such discharge.

The act contains enforcement and implementation provisions in the form of several remedies available to the regional boards, and the State Board in review thereof, in case of noncompliance with the plans and policies.

The original act provided a limited amount of funds for assistance to local public agencies who could show that public funds were not reasonably available. Subsequently, recognizing that water pollution control is also of state interest and responsibility, the Legislature created a Clean Water Finance Committee and authorized it to set up a bond fund for grants in the amount of $250 million to aid municipalities in the construction of eligible projects and for reclamation of water. The State Board was named the administrator of the fund and was authorized to enter into contract with municipalities to provide the minimum amount required by federal law at that time for the project to qualify for the maximum federal assistance. The new federal law does not require a minimum state participation.

The State Board is also designated the administrator of any program of financial assistance for water quality control and may accept federal and other funds to that end. The State Board is required to prepare lists of needed collection,

treatment, and disposal systems and to review and approve each application for a project grant. The State Board shall determine conformity of the project with the approved water quality control plan and that the project is entitled to priority over other eligible projects on the basis of financial as well as water pollution control needs.

The Porter-Cologne Act directly addresses the problem of water reclamation and reuse. A declared policy of the law was that the people of the State have a primary interest in the development of facilities to reclaim water containing waste to supplement existing surface and underground water supplies to assist in meeting the water requirements of the State. The legislative intent was to undertake all possible development of water reclamation facilities to make reclaimed water available for use. The law requires the State Department of Public Health to establish statewide reclamation criteria for each type of use where such use involves public health. Any person proposing to reclaim wastewater or proposing to use reclaimed wastewater must file with the regional board a report containing information required by the board. The board, after consulting with the State Department of Public Health, will prescribe water reclamation requirements either for the person reclaiming water or the user, or both. This chapter also prohibits the use of wells for the disposal of waste except that if water quality and public health consideration do not preclude recharge by direct injection, discharge requirements may be imposed by the regional board for this method of discharge.

Water Code

Several other sections of the Water Code affect the basin plans. Sections 1242-58 allow the State Board to approve the appropriation of unappropriated water for storage to be released for purposes of protecting or enhancing the quality of waters which are beneficially used. In acting on these applications, the State Board shall consider the relative benefit derived from all beneficial uses to be protected and the reuse or reclamation of water. The State Board may condition such appropriations by such terms that will best develop and utilize, in the public interest, the water to be appropriated. The State Board may reserve from appropriation water needed for instream uses, including quality control. The powers of the State Board include the right to impose terms and conditions upon permits, including those regarding maintenance of quality for beneficial uses and to retain jurisdiction over the permits issued.

Section 2100 of the Water Code provides for adjudication to protect ground water quality. The State Board, upon a finding of existing or threatened irreparable damage, may file an action in the Superior Court to restrict pumping or to impose physical solutions, or both, to the extent necessary to prevent destruction of or irreparable injury to the quality of groundwater. The State Board may take such action only if an affected local agency fails to do so.

The Water Code contains provisions which control almost every consideration of water and its use. Division 2 covers the appropriation of water and water

rights; Division 3 deals with dams and reservoirs; Division 5 pertains to flood control; Division 6 controls conservation, development, and utilization of the state water resources; Division 7, described in detail above, covers water quality; and Divisions 11 through 21 provide for the organization, operation, and financing of irrigation, county water, California water, California water storage, reclamation, county water works, drainage, water replenishment, levee, municipal water, water conservation districts, respectively. Regulations relative to well drilling, well drilling standards, and abandonment of wells are contained in Sections 13700 et seq.

California Environmental Quality Act of 1970 (CEQA)

CEQA is contained in Sections 2100 to 21150 of the Public Resources Code. It was amended by AB 301 of the 1972 Session of the Legislature. CEQA, companion to the Federal NEPA, requires all state agencies, boards, and commissions to include, in any report on any project having significant effect on the environment, an environmental impact statement. CEQA requires, in addition to the five items set forth in Section 102 of NEPA, that the statement include a discussion of mitigation measures proposed to minimize the impact. It further requires consultation with and comments from any governmental agency which has jurisdiction or special expertise with respect to any environmental impact involved. AB 301 requires that the boundaries of the area which may be affected by the project be identified and that the growth-inducing impact of the proposed action be included in the statement. The responsibility for development of objectives, criteria, and procedures to assure proper preparation and evaluation of the statements was placed with the Office of Planning and Research.

California Administrative Code

The administrative procedures of the State Board are contained in Title 23, Chapter 3, of the California Administrative Code. Regulations relating to water rights, discharge enforcement, grant administration and other State Board functions are set forth in several subchapters. The disposal of solid wastes is governed by Sections 2500-2550 of the code. A disposal site and wastes classification system are established. Regional boards are required to set standards and establish discharge requirements as necessary to protect water quality.

Title 17 (Public Health) of this code contains requirements for quality of water for domestic uses and restrictions on the uses of waters reclaimed from wastewaters.

Other Codes

Portions of various other codes, such as the Health and Safety Code, Fish and Game Code, Public Resources Code, and Revenue and Taxation Code, impose regulation upon the basin planning program. The Health and Safety Code contains regulations relating to the formation and operation of county sanitation and sewer maintenance districts, sewer revenue bonds, the use by the

public of reservoirs, and ocean water-contact sport. The Fish and Game Code provides for the preservation, protection, and enhancement of birds, mammals, fish, amphibia, and reptiles and their habitats and food chains.

A recent law, Maximum Property Tax Rates for Units of Local Government, SB 90 of 1972 (Revenue and Tax Code, Chapter 15) intends to establish limits on property tax rates in an effort to provide property tax relief. The law provides that the maximum property tax rate shall be that levied by the local government for the 1972-73 fiscal year. This applies to counties, cities, and special districts. The law allows certain increases according to a restrictive formula and a rate change by a majority vote in an election called for that purpose. A problem is created by Section 2163 of that law which provides that the State will pay to each type of local government, including special districts, an amount to reimburse local government for the full costs of any new state-mandated program or any increased level of service of an existing mandated program. Further, if a local government has been providing a service or program at its option which is subsequently mandated by the State, the State shall pay such local government for such mandated service or program and the local government shall reduce its property tax by the amount of the state payment that replaces property tax revenues expended on such service or program.

The Office of Legislative Counsel has interpreted that prohibitions, effluent limitations, and recommendations for facilities contained in water quality plans are "state executive regulations" which require state reimbursement of the local share for an "increased level of service of an existing program". This matter is not settled in that it is possible that the Attorney General or the courts will have a different interpretation. No clear and certain direction in this regard is available at present. If the above interpretation of the Legislative Counsel is overturned or that provision of the law is repealed, the only way that projects for water quality control can go forward is through a majority vote of the people in the local jurisdiction.

PLANS

The California Water Plan

Part 1.5, Division 6, of the Water Code, set forth in 1959, describes the California Water Plan as "The plan for the orderly development and co-ordinated control, protection, conservation, development and utilization of the water resources of the State which is set forth and described in Bulletin No. 1 of the State Water Resources Board entitled 'Water Resources of California,' Bulletin No. 2 of the State Water Resources Board entitled 'Water Utilization and Requirements of California,' and Bulletin No. 3 of the Department of Water Resources entitled, 'The California Water Plan,' with such amendments, supplements and additions as may be later necessary...."

Thermal Plan

The State Water Resources Control Board adopted, on May 18, 1972, a "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California", referred to as the "Thermal Plan". The plan specifies limiting conditions of temperature in wastewaters discharged into interstate and coastal waters, estuaries, and enclosed bays. For example, elevated temperature waste discharges into interstate waters designed as "cold" waters are prohibited while this type of discharge into "warm" interstate waters cannot be more than 5°F warmer than the receiving water and shall not cause the temperature in the receiving water to rise more than 5°F. Existing thermal discharges into coastal waters, estuaries, and enclosed bays shall comply with limitations necessary to assure protection of the beneficial uses and, or coastal waters, areas of special biological significance. Other specific limitations are contained in the plan. Regional boards administer the plan by establishing waste discharge requirements for discharges of elevated temperature wastes. Existing and future discharges of thermal waste are required to define the effect of the discharge on the beneficial uses, and for existing discharges, determine the necessary design and operating changes needed to comply with the plan objectives. The plan requires the earliest possible compliance but not later than January 1976.

Policies and Regulations

State Policy for Water Quality Control

The State Board has developed a set of 12 general principles to implement the provisions and intent of the Porter-Cologne Act. These principles, listed below, are contained in a document called the "State Policy for Water Quality Control".

1. Water rights and quality control decisions must assure protection of fresh and marine waters for maximum beneficial use.

2. Wastewaters must be considered a part of the total available fresh water resources.

3. Management of supplies and wastewaters shall be on a regional basis for efficient utilization of the resource.

4. Efficient wastewater management requires a balanced program of source control of hazardous substances and treatment, reuse, and proper disposal of effluents and residuals.

5. Substances not amenable to removal in treatment plants must be prevented from entering the system.

6. Treatment systems must provide sufficient removals to protect beneficial uses and aquatic communities.

7. Sewerage facilities must be consolidated for long-range economic and water quality benefits.

8. Institutional and financial programs of consolidated systems must serve each area equitably.

9. Reclamation and reuse of maximum benefit shall be encouraged.

10. Systems must be designed and operated for maximum benefit from expended funds.

11. Control methods must be based on the latest information.

12. Monitoring programs must be provided.

The policy provides that secondary treatment will be the minimum acceptable level of treatment. Advanced treatment systems will be required where necessary to meet quality objectives.

Non-Degradation Policy

Resolution No. 68-16 of the State Water Resources Control Board is the "Statement of Policy with Respect to Maintaining High Quality of Waters in California", commonly referred to as the "non-degradation policy". The quality of some of the waters of the State is higher than that established by the adopted policies and it is the intent of this policy that such higher quality be maintained to the maximum extent possible. Wherever this condition exists, such high quality will be maintained unless it can be demonstrated that any change will be consistent with maximum benefit to the people of the State and will not unreasonably affect present and anticipated beneficial use of such water. Discharge requirements for wastewater discharges to existing high quality waters shall impose the best practicable treatment technology or control of the discharge as necessary to assure the highest quality consistent with maximum benefit to the people of the State.

Areas of Special Biological Significance

Both the thermal and ocean plans recognize and refer to areas of special biological significance in coastal waters of the State. The regional boards were furnished guidelines for and required to select areas in coastal waters where, because they contain biological communities of such extraordinary, even though unquantifiable, value that no acceptable risk of change in their environments as a result of man's activities can be entertained. The impact of the adoption of areas of special biological significance on the basin plan is that discharges of wastewaters and/or heat must be sufficiently removed spatially from these areas as to assure the maintenance of natural water quality in the area. Existing wastewater and/or heat discharges which influence the natural water quality in the designated areas must be phased out as promptly as possible.

Clean Water Grants

Because of the effect of grant monies from federal and state

sources on the financial considerations of the plan, it is essential that planners be aware of regulations which govern grants. The administration of both federal and state grant programs for construction of wastewater treatment facilities is vested in the State Water Resources Control Board. The grant program is implemented by regulations contained in Title 23, Chapter 3, Subchapter 7 of the California Administrative Code, adopted initially on April 1, 1971. Several revisions to the regulations have been adopted. Portions of the regulations affecting basin plans define grant-eligible facilities, require sound and equitable revenue programs encouraging user charges, limit grant support for future capacity require in-depth evaluation of alternatives, and limit subsidies to industrial waste dischargers.

Guidelines

Guidelines are developed to aid in the implementation of laws and regualtions. An example is The Resources Agency of California publication, "Guidelines for Implementation of the California Environmental Quality Act of 1970", published February 5, 1973. These guidelines set forth the conditions under which an environmental impact report (EIR) must be prepared, provide instructions for the preparation of EIRs, and establish procedures for review of EIRs. Many guidelines have been developed by the State Board's Grants Team for the implementation and administration of the grants program.

Management Memoranda

Management memoranda are essentially guidelines which have been issued by the Division of Planning and Research of the State Board to provide direction and instructions to the basin contractors and regional board staffs in relation to the current comprehensive basin planning programs. Management memoranda command no legal status but serve to provide criteria and bases to be adhered to in the preparation of the basin plans. More than 25 management memoranda have been issued during the planning program.

Water Rights Decisions

Division 2 of the Water Code provides that the State Board shall consider and act upon all applications for permits to appropriate waters and shall do all things required or proper relating to such applications. The State Board has the authority to impose conditions of use in granting the right to retain jurisdiction, i.e., subsequently change the conditions. The conditions of the permit are contained in a water rights decision, which is an enforceable document.

LOCAL POLICIES

There are two major regional planning agencies in the West Colorado River Basin: the Southern California Association of Governments (SCAG), and the Comprehensive Planning Organization of San Diego Region (CPO). In addition there are four

counties, each with its own planning department, and over 40 local agencies that have governmental powers for providing sewer and/or water services. Each of these agencies has its own respective goals and policies, many of them unwritten. However, insofar as those goals and policies are related to areawide planning frameworks, the first level at which policies become integrated is general plans and land-use maps of each county in which goals and policies are usually articulated verbally and pictorially. Also, the counties' general plans and land-use maps are still further integrated on a regional basis by their respective regional agencies. The locations of these regional planning agencies are shown on Figure 9-1. But it must be pointed out that information relating to general plans and land-use maps, both at county and regional planning agency levels, is set by governmental bodies -- county Boards of Supervisors or City Councils.

Most of the local agencies providing specific public services directly or indirectly related to water quality, are comparatively isolated agencies scattered throughout the basin. They derive their authority from specific governmental paowers for specific purposes. In general, therefore, their policies are directed to carrying out effectively certain definite, but limited purpose for which they have been empowered. Consequently, on an areawide basis, their policies are independent of those of other agencies since their service areas are circumscribed specifically.

Local agencies' policies are being updated and made more definite in order to meet federal and state requirements for attaining more effective protection and enhancement of the environment. Thus, after many years of coordinating its member agencies' policies, SCAG adopted a set of goals and guidelines in February 1973 and specific policies in September 1973, which it published in "SCAG Regional Development Guide: Proposed Policies."

SCAG developed a definite set of goals and policies for each of these subjects: (A) population and urbanization, (B) land use and form, (C) housing and community development, (D) transportation, (E) environmental management, (F) economic development (G) education, (H) open space/natural resources/recreation, and (I) criminal justice.

Under (E), "environmental management," SCAG evolved the following policies for: (a) water quality, (b) air quality, (c) noise reduction, (d) solid waste, (e) natural/man-made hazards, (f) conservation and development of energy, (g) radiation, (h) pesticides, (i) thermal, and (j) liquid waste.

For example, for water quality, it established these specific policies:

1. SCAG shall support development of water, sewer, flood control, and solid waste facilities in such way as to enhance, or minimize disruption of, the ecological balance of the environment.

CHAPTER 11: PHYSICAL AND HYDROLOGIC CHARACTERISTICS

For planning and reporting purposes, the Basin has been divided into the following six major Planning Areas on the basis of different economic and hydrologic characteristics (Figure 11-1).

1. Lucerne Valley
2. Hayfield
3. Coachella Valley
4. Anza-Borrego
5. Imperial Valley
6. Salton Sea

GEOGRAPHICAL SETTING

The West Colorado River Basin occupies 10 million acres (16,000 square miles) in the southeastern portion of California (Figure 11-1), and includes portions of San Bernardino, Riverside, San Diego, and Imperial Counties. It is bounded on the north by the Ord, Bristol, Granite, Providence, and New York Mountains; on the east, by the drainage divide of the Colorado River; on the south, by the International Boundary between the United States and Mexico; and on the west by the Granite, San Bernardino, San Jacinto, and Laguna Mountains. The Basin is 200 miles long from north to south and 75 miles to 150 miles wide from east to west. Its most geographically significant feature is the Salton Trough, which contains the Salton Sea and the Coachella and Imperial Valleys. The Trough is a structural extension of the Gulf of Lower California and in ancient times contained the huge Lake Cahuilla. Most of the economy and industry of the West Colorado River Basin is concentrated in this part of the Basin.

The Basin's economy is based almost entirely on agriculture, resorts, and recreation in special areas, but much of the Basin still remains undeveloped. Iron mining is a major industry, but is presently represented by only one mine. For the future, agriculture is expected to experience little growth, while increased urbanization is expected with increased development of resorts and retirement communities.

Topography

The Basin spreads into three California geomorphic provinces. The Lucerne Valley and Hayfield Planning Areas are in the Mojave Desert province, the Coachella Valley and Imperial Valley Planning Areas are in the Colorado Desert province, and the Anza-Borrego Planning Area is in the Peninsular Ranges province.

The characteristics of each province are different. The Lucerne and Hayfield Planning Areas are made up of intermittent barren mountains and valleys that form many individual internal drainage basins, with dry lakes at their lower elevations.

The Coachella Valley and Imperial Valley Planning Areas are both in the long depression that comprises the landward extension of the Gulf of Lower California.

The two valleys are separated by the Salton Sea, which occupies the lowest area of the depression. The highlands on the southwest boundary of the Coachella Valley Planning Area, the San Jacinto

and Santa Rosa Mountains, are part of the Peninsular Ranges province and are over 10,000 feet high.

Most of the Anza-Borrego Planning Area is in the Peninsular Ranges province. It consists essentially of low dissected hills and small valleys. The land elevations range from about 5,000 feet at the crest of the west boundary to below sea level at the Salton Sea.

The Salton Sea, located on the site of prehistoric lakes, was formed in 1905 by overflow of the Colorado River. Today, it serves as a drainage receptacle for irrigation return water from the Coachella Valley, Imperial Valley, and Anza-Borrego Planning Areas.

Geology

The mountains consist of igneous, metamorphic, and volcanic rocks of pre-Cambrian to Tertiary age, and the sediments in the intervening valleys are poorly consolidated-to-unconsolidated sediments of Quaternary age. Northwest-trending faults are extensive and are the prominent factor in determining the configuration of the land. The famous San Andreas fault zone cuts diagonally across the lower third of the Basin and forms the highlands on the northeast side of the Salton Sea Trough. The Borrego Valley is a typical fault valley formed by the San Jacinto fault. The valleys, mountains and dry lakes all trend toward the northwest, with the major fault systems.

The Coachella and Imperial Valleys were created when the Colorado River formed a delta that isolated the Trough from the Sea. Subsequently, under desert conditions, the inland sea dried up. Later the Trough was occupied by lakes at different times, and deposition into these lakes gives the valleys their characteristic flatlands and fertile soils.

The Anza-Borrego Planning Area is made up of the old California batholith that has been weathered and eroded; today only low dissected hills remain.

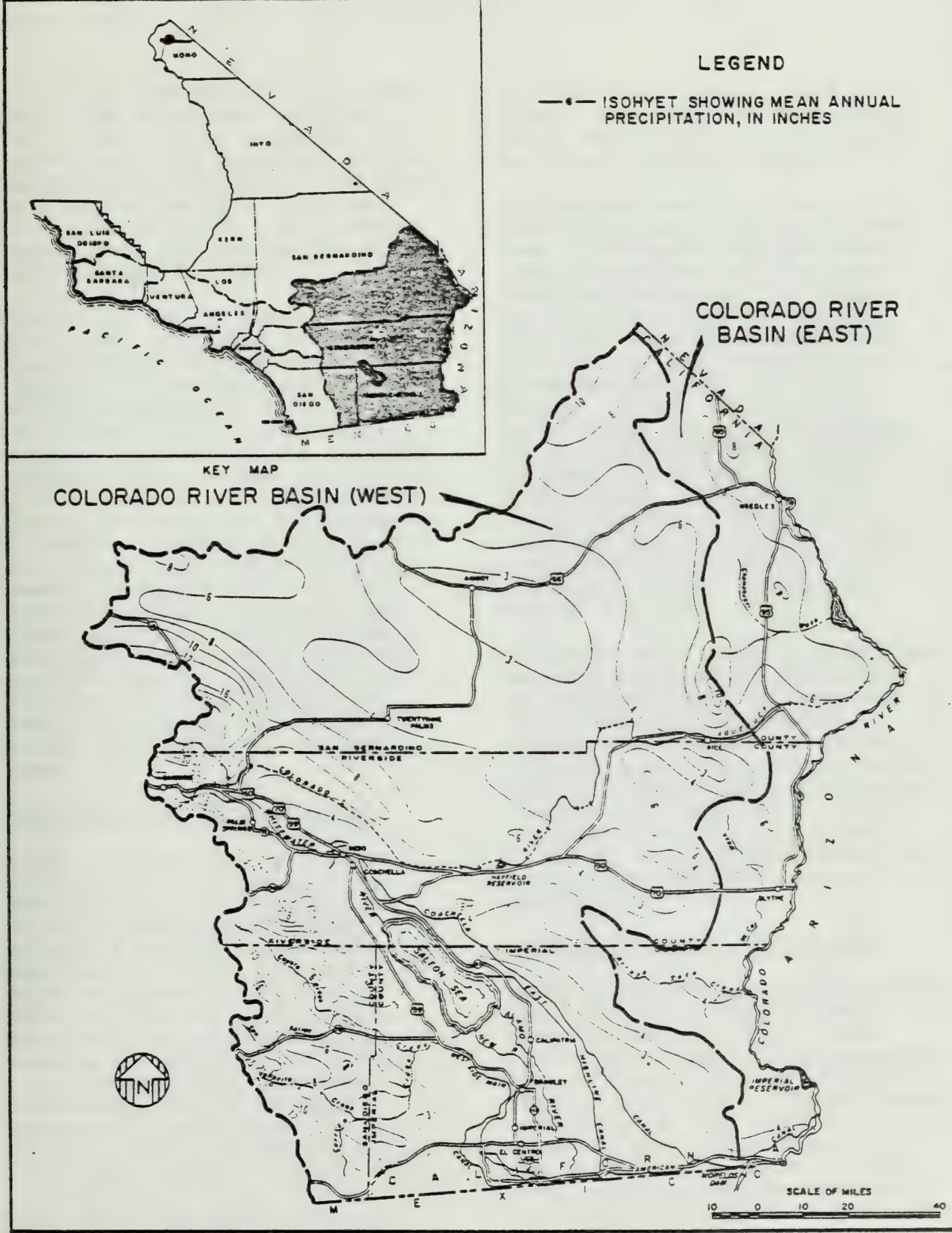
Major Hydrographic Features

The northern half of the Basin drains to many individual internal sinks, or playas, while the southern half drains to the Salton Sea. Natural perennial streams are found only along the western boundary of the Basin in the San Bernardino and San Jacinto Mountains. All these natural streams are diverted for the water supply of local communities. Other perennial streams and canals are found in the Imperial and Coachella Valleys as a result of irrigation returns.

The Salton Sea, now maintained by irrigation return water, is the largest and most important body of water in the Basin. Although the Sea is highly saline, due to the concentration of salts by evaporation, it is used extensively for boating and fishing. Other man-made recreational lakes are found in the Imperial Valley. In addition, the recently completed Lake Cahuilla in Coachella Valley is used to store irrigation water from the Colorado River and for recreation as well.

Climate

The Basin has the driest climate in California. Its winters are



EAST AND WEST COLORADO RIVER BASINS
Isohyetal Map
Figure 11–1

mild, its summers hot, with temperatures sometimes reaching 120° F and winter temperatures below zero. An exception is the Salton Trough, where ground surface elevations are below sea level and frost is a rare occurrence, thus permitting the growing of crops all year.

Snow falls in the Basin's higher elevation, with mean seasonal precipitation in the upper San Jacinto and San Bernardino Mountains ranging from 30 to 40 inches (Figure 11-1). The lower elevations receive little rainfall. Typical mean seasonal precipitation in the desert valleys is 3.6 inches at Indio and 3.2 inches at El Centro. Precipitation over the entire area occurs from November through April, but its distribution and intensity are often sporadic. Local thunderstorms may contribute the average seasonal precipitation at one time, or only a trace of precipitation may be recorded at any locale for the entire season.

Fish and Wildlife Resources

Large areas of the Basin are habitable only by animals tolerant of arid conditions. Although inconspicuous, these animals flourish in the Colorado Desert. Small rodents, coyotes, foxes, birds, and reptiles live in this environment but are seen only by the experienced observer. In the higher elevations of the San Bernardino and San Jacinto Mountains, where water is more abundant, deer and sheep, along with small animals, may be found.

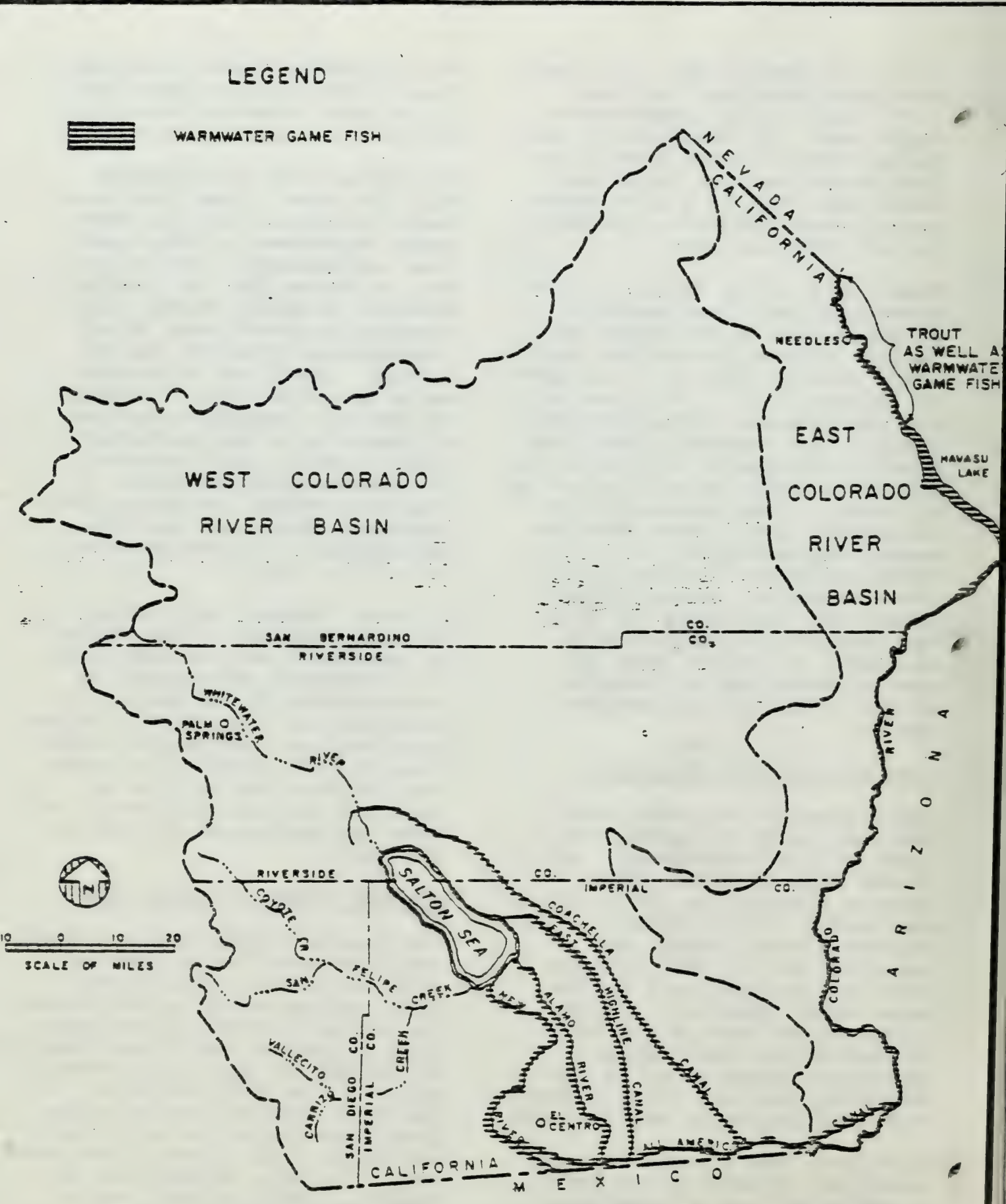
Fish have been planted in the perennial streams of the Basin. In addition, the All-American and Coachella Canals also provide a waterway for game fish in an area otherwise devoid of any kind of sport fishing.

The Salton Sea is a managed wildlife area. Game fish have been introduced and are taken under Department of Fish and Game regulations. The Salton Sea is famous for its Corvina fishery, a worthy trophy fish that has thrived since being transplanted from the Sea of Cortez. Local and migratory water birds are also attracted to the Sea; extensive hunting of these birds has disrupted their normal living pattern. For conservation purposes, a wildlife refuge, primarily for migratory fowl, has been established at the southeastern end of the Sea.

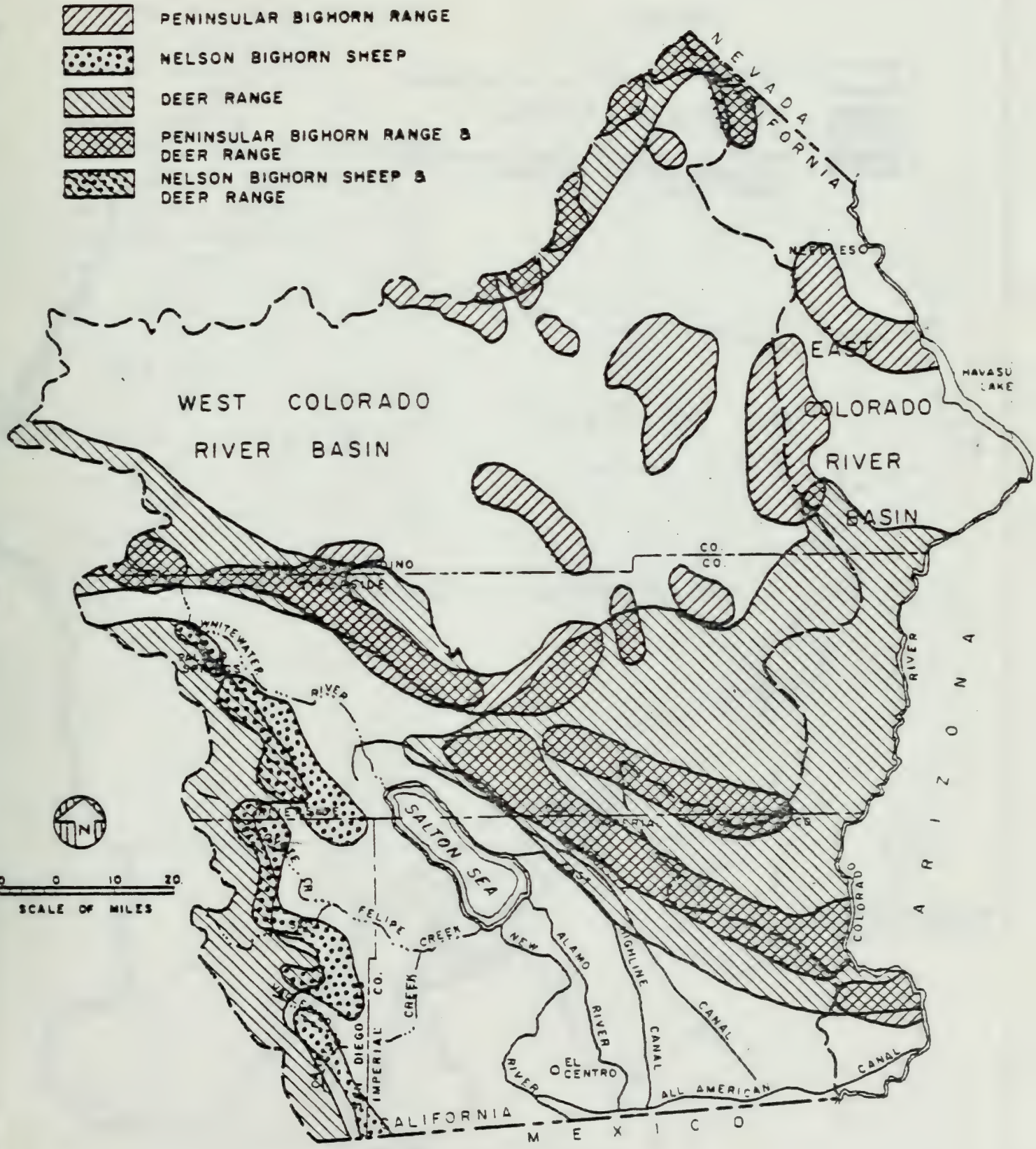
Although hunting and fishing are popular pastimes in the Basin, an important part of the wildlife resources management is preservation of the desert environment and its animals, birds, reptiles, and indigenous plants. Figures 11-2 through 11-5 show the distribution of fish and wildlife, key habitat areas, and rare and endangered species in the Basin.

LUCERNE VALLEY PLANNING AREA

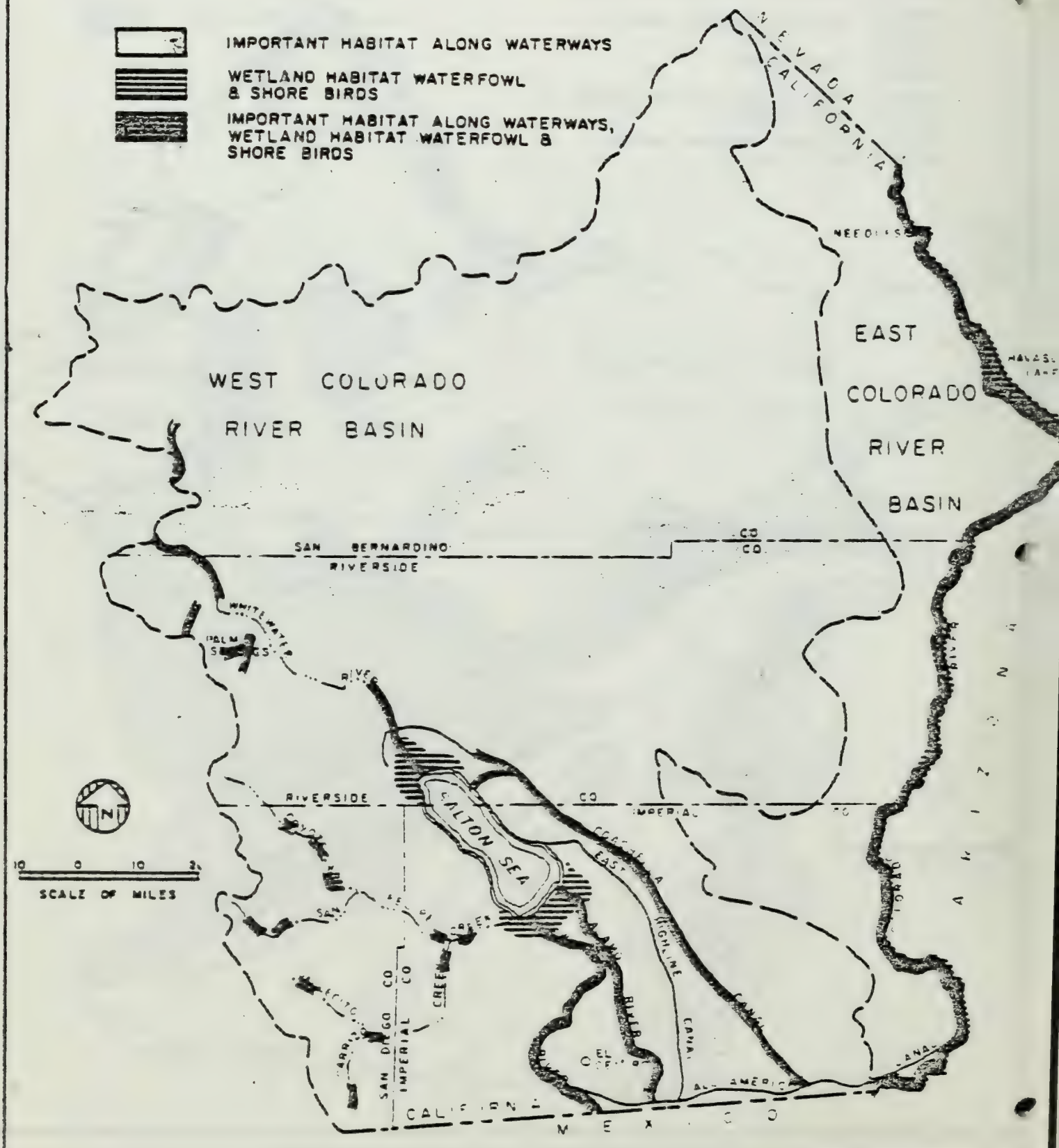
The Lucerne Valley Planning Area comprises many small internal drainage basins, which cover 6,500 square miles, approximately the northern third of the Basin. This is part of the "Upper Desert", as opposed to the "Lower Desert", which is the Salton Trough. In the upper desert, spring comes later, precipitation is higher, and frost often forms in the winter. The main communities are Lucerne, Yucca Valley, Joshua Tree, and Twentynine Palms.



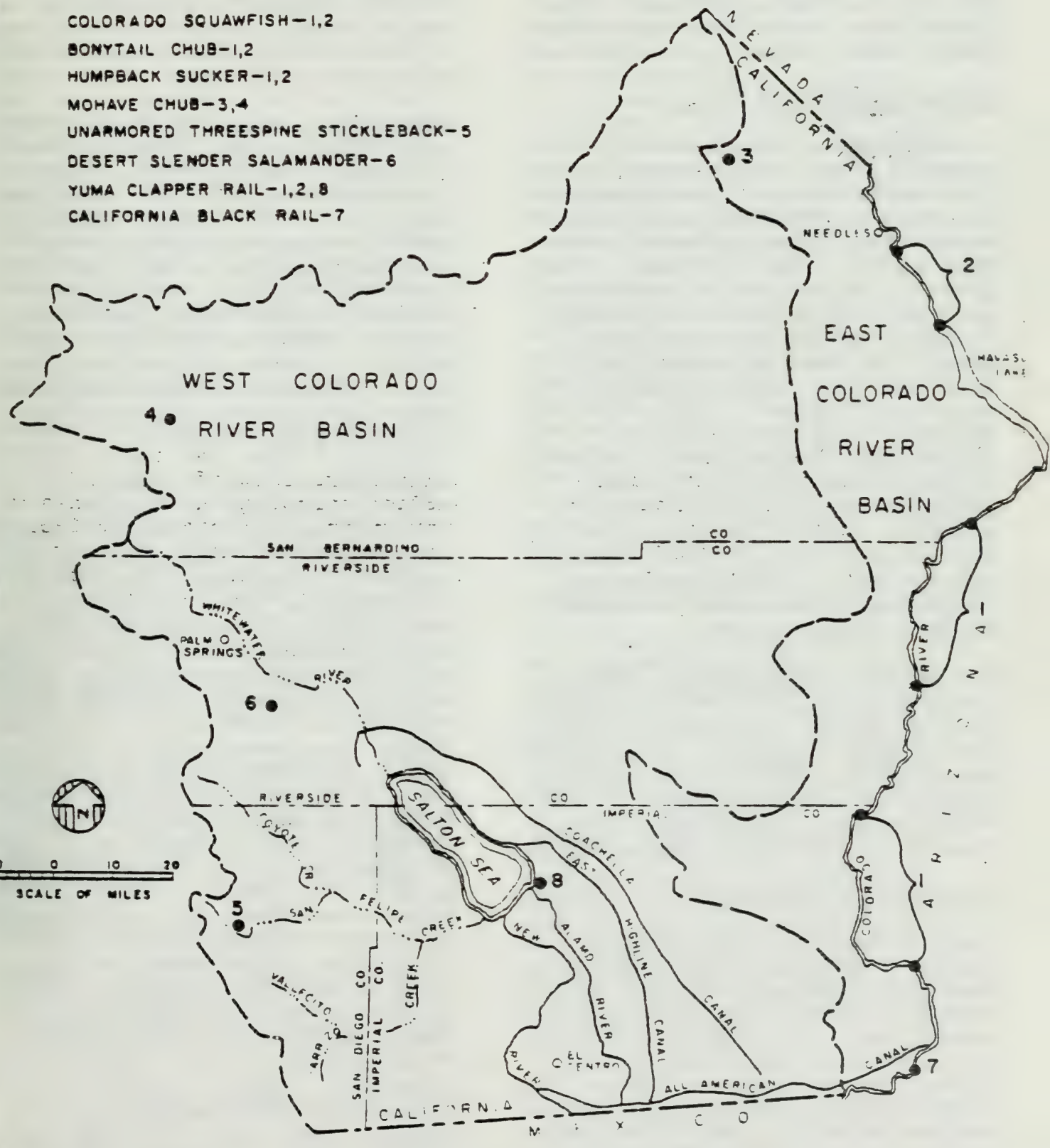
EAST AND WEST COLORADO RIVER BASINS
Warmwater Game Fish and Trout Distribution
Figure II-2



EAST AND WEST COLORADO RIVER BASINS
Deer Range, Peninsular Bighorn Range, & Nelson Bighorn Sheep Range
Figure 11-3



EAST AND WEST COLORADO RIVER BASINS
Important Habitat Along Waterways and Wetland Habitat for Waterfowl and Shore Birds
Figure II–4



EAST AND WEST COLORADO RIVER BASINS
Rare and Endangered Species Distribution
Figure II-5

The San Bernardino Mountains, on the northwest, have the highest peaks in the Planning Area. Elevations in the San Bernardino Range often exceed 7,000 feet.

Surface Water Hydrology

Precipitation occurs mostly as rainfall, with some snowfall in the San Bernardino Mountains. Rainfall is sporadic and amounts vary widely from place to place. Mean annual precipitation ranges from 16 inches in the San Bernardino Mountains to less than 3 inches in the Bristol Lake area; the average annual rainfall over the whole Planning Area is 5 inches. Little of the rain percolates to the groundwater table; most is lost by evapotranspiration. Only when cloudbursts bring large volumes of water is there sufficient moisture to percolate and replenish the groundwater. There are no perennial streams in the Planning Area.

The Mojave Water Agency (MWA) has contracted for 50,800 acre-feet of water per year from the State Water Project. This water can be made available to meet the future water demands of the communities of Lucerne, Yucca Valley, Joshua Tree, and Landers.

Groundwater Hydrology

Groundwater is stored mainly in the unconsolidated alluvium. Except for areas near some of the dry lakes, groundwater is unconfined. The depth of the water-bearing deposits is not known, but the basins have accumulated hundreds of feet of sediments; e.g., 1,200 feet of sediments have been measured in the Dale hydrologic subunit.

Wells yield from a few gallons per minute (gpm) to 3,000 gpm. In 1970, depth to groundwater ranged from flow at the surface to 445 feet in the Copper Mountain hydrologic unit.

Subsurface inflow from the Piute hydrologic subunit and Broadwell hydrologic unit to the Lucerne Planning Area is small. On the other hand, an average annual 100 acre-feet flows from the Lucerne hydrologic unit into the Upper Mojave River hydrologic subunit in the South Lahontan Basin. There is also an undetermined amount of outflow from Cadiz hydrologic unit into Palen hydrologic subunit of the Hayfield Planning Area.

Groundwater flow follows the general gradient of the land surface except in areas of heavy extraction and where subsurface flow may be affected by faults. The Baseline fault along the south side of Twentynine Palms Valley causes a long linear zone of rising water covered by dense vegetation, which includes the Twentynine Palms Oasis. Another fault, the Mesquite Dry Lake fault, intersects the Baseline fault 4 miles east of Twentynine Palms and impedes groundwater movement locally, causing a higher water table on the southwest side of the fault. Other faults have less effect on the hydrology, but may be responsible for high fluorides in the water and for high water temperatures. Wells in the Dale hydrologic unit yield water with temperatures ranging from 70° to 118° F.

HAYFIELD PLANNING AREA

The Hayfield Planning Area contains the Rice, Chuckwalla, and

Hayfield hydrologic units (Plate 1). Lying almost entirely in Riverside County, it covers 1,860 square miles in the east central portion of the Basin. The Hayfield Planning Area is a desert, with barren mountains and valleys and dry lake beds at the lower elevations. The Area is bounded on the south by the Chuckwalla and Granite Mountains; on the north by the Pinto and Granite Mountains; and on the east by the McCoy Mountains. The highest elevation in the Planning Area is close to 4,000 feet, but most of the mountain tops are at much lower elevations.

Surface Water Hydrology

Average annual precipitation ranges from less than 3 inches in the lower valley to 8 inches in the higher elevations of the Little San Bernardino Mountains. The average annual runoff for the Area, which occurs principally during thunderstorms, is 5,000 acre-feet. No perennial streams flow in the Planning Area. Almost all the moisture from rain is lost through evaporation and evapotranspiration.

Another source of surface water is the Colorado River Aqueduct. Small amounts of water from the Aqueduct are used for domestic purposes at MWD's Eagle Mountain and Hayfield Pumping Stations.

Groundwater Hydrology

Runoff from the higher elevations is the main source of recharge of the groundwater basin. Smaller amounts percolate to the groundwater table from direct precipitation. Water in storage is generally unconfined in the sediments that fill the valleys. Water levels range from the surface down to 400 feet.

Wells in the Planning Area yield from a few gpm to over 5,000 gpm. The water-bearing sediments have been penetrated to a depth of 1,200 feet. In the last 20 years, groundwater levels have dropped as much as 9 feet in the Palen hydrologic subunit. Most of the pumping in the Basin is done in this subunit by the Kaiser Steel Corporation for industrial use.

Groundwater flow generally follows the gradient of the land surface but may be affected by pumping depressions and by the local geology of the nonwater-bearing rocks. An example is the subsurface basalt dike that impedes groundwater movement at the east end of the Pinto hydrologic subunit and prevents flow into the adjoining Palen hydrologic subunit.

COACHELLA VALLEY PLANNING AREA

This Planning Area contains the Whitewater hydrologic subunit and the East Salton Sea hydrologic unit. It lies almost entirely in Riverside County and occupies 1,920 square miles in the west central portion of the Basin. The San Bernardino Mountains and the Little San Bernardino Mountains form the northern boundary; the San Jacinto and Santa Rosa Mountains and the Salton Sea shoreline form the southern boundary. Elevations range from over 10,000 feet in the San Jacinto Mountains to 230 feet below sea level at the Salton Sea shoreline.

The San Bernardino and San Jacinto Mountains have evergreen forests with perennial streams. A

contrasting scene is presented on the Coachella Valley floor; there, the land is parched and vegetation is sparse, except where the land has been irrigated for farming.

Surface Water Hydrology

Average annual precipitation ranges from less than 3 inches in the valleys to 40 inches in the San Bernardino Mountains. Seasonal snows fall on the higher elevations in the San Bernardino and San Jacinto Mountains. In the valleys, summer thunderstorms are common, and summertime precipitation often exceeds that of winter.

Runoff resulting from rains and snowmelt at the higher elevations is the major source of groundwater replenishment. Perennial flow occurs in the upper reaches of the Big Morongo Creek, San Gorgonio and Whitewater Rivers, and Palm Canyon, Tahquitz, Snow and Andreas Creeks. Table 11-1 presents the average annual runoff for selected streams.

The Whitewater River is the major drainage course in the Planning Area. There is perennial flow in the mountains, but, because of diversions and percolation into the Basin, the river flows in the valley only after heavy storms. The constructed downstream extension of the rivwe channel serves as a depository and drainage way for irrigation return water, treated wastewater, and storm runoff. Since 1965 the average annual flow to the Salton Sea via the Whitewater River channel has been about 100,000 acre-feet.

Estimated average annual streamflows in ungaged streams in the Planning Area are shown on Table 11-2. Most of the runoff in these stream channels is diverted for water supply.

There is one large surface water impoundment. Lake Cahuilla, at the end of the Coachella Canal, serves as a storage reservoir to meet unexpected irrigation water demands brought about by changes in weather.

Groundwater Hydrology

Groundwater is stored mainly in the unconsolidated Pleistocene sediments. Wells yield up to 4,000 gpm. The water-bearing sediments are about 2,800 feet thick in the Coachella Valley floor.

Groundwater is generally unconfined in the Basin except in the Coachella Valley. A clay cap layer, a result of the sedimentation in the Old Lake bed, extends from the Salton Sea to near Indio, overlying two good aquifers. The clay layer contains lenses of permeable sediments and perched groundwater, which are replenished by percolating irrigation water.

The Planning Area is faulted extensively, altering groundwater movement. The Mission Creek, Banning, and San Andreas faults form effective barriers to groundwater movement; the Indio Hills, Garnet Hills, and Mecca faults form partial barriers.

The Indio and Mecca Hills have been uplifted along the northwest-southeast-trending San Andreas fault system. The

TABLE 11-1

SELECTED SURFACE WATER RUNOFF DATA
IN THE COACHELLA VALLEY PLANNING AREA

Hydrologic Subdivision	Station	Number of Years of Record	Average Runoff, in acre-feet/year for period of record	Drainage Area in sq. mi.
Shavers subunit	Cottonwood Creek near Willow Springs	11	1	0.71
East Salton Sea unit	Salton Creek*	9	4,300	269.0
Garnet Hill subarea	Whitewater River at Whitewater	22	12,300	57.4
Miracle Hill subarea	Long Creek near Desert Hot Springs	7	1	19.4
Indio subarea	Andreas Creek near Palm Springs	22	1,600	8.61
	Palm Canyon Creek near Palm Springs	34	2,700	93.3
	Snow Creek near Whitewater	18	6,200	10.8
	Tahquitz Creek near Palm Springs	23	3,000	16.8
	Deep Canyon Creek near Palm Desert	8	530	30.6

* Flow sustained by irrigation seepage
** Runoff figures have been rounded off

alignment of oases on the flanks of those hills results from faults that impede the movement of groundwater. The most prominent of these oases is the Thousand Palms Oasis on the main trace of the San Andreas fault.

ANZA-BORREGO PLANNING AREA

This Planning Area includes the Clark, West Salton Sea, and Anza-Borrego hydrographic units. It comprises 1,000 square miles in the southwest corner of the Basin, mostly in San Diego and Imperial Counties, with a small segment in San Bernadino County. The boundaries of Anza-Borrego run along the divide between the Salton Trough and the Pacific Ocean on the west, the southwest drainage divide of Coachella Valley, the southwestern Salton Sea shore, the western boundary of the Imperial Valley, and the Mexican border.

TABLE 11-2

ESTIMATED AVERAGE ANNUAL STREAMFLOW FROM UNGAGED STREAMS IN THE COACHELLA VALLEY PLANNING AREA*

Hydrologic Subdivision	Stream	Runoff, in acre-feet**
San Gorgonio Subunit	San Gorgonio River	1,000
Mission Creek Subarea	Mission Creek	2,000
	Morongo Canyon	1,500
Indio Subarea	Falls Creek	1,000
	Chino Creek	2,500

* USGS "Analog Study of the Ground-Water Basin of the Upper Coachella Valley, California," 1971.
**Estimated at the ground-water basin boundary.

Elevations range from 280 feet below sea level at the Salton Sea to over 6,000 feet along the western boundary. The principal communities in the Planning Area are Salton Sea and Borrego Springs.

Surface Water Hydrology

Drainage flows to the Salton Sea, except for two small areas of internal drainage in Clark and Borrego Valleys in the northwest corner of the Planning Area.

Average annual precipitation ranges from less than 3 inches along the eastern boundary, near Imperial Valley, to 25 inches in the mountain divide between the Salton Sea and Pacific Ocean drainage.

Runoff comes from precipitation in the higher elevations during the winter and from summer thunderstorms in the lower desert around the Salton Sea, Borrego Springs, and Imperial Valley. Perennial flow occurs in Coyote and San Felipe Creeks. Table 11-3 presents annual surface runoff from selected gaging stations. Average seasonal runoff for the Planning Area has been estimated at 24,000 acre-feet.

Groundwater Hydrology

Groundwater is pumped mainly from the unconsolidated Pleistocene sediments but some is pumped from low-yield wells that extend to weathered and fractured bedrock.

TABLE 11-3

SELECTED SURFACE RUNOFF DATA IN THE ANZA-BORREGO PLANNING AREA

Hydrologic Subunits	Station	Number of Years of Record	Average Runoff, in acre-feet/year, for Period of Record	Drainage, in sq. miles
Borrego	Coyote Creek near Borrego Springs	20	1,490	144.0
	Borrego Palm Creek near Borrego Springs	20	268	21.8
Octillo-Lower San Felipe	San Felipe Creek* near Westmorland	9	3,150	1,693.0
Mescal Bajada	San Felipe Creek** near Julian	12	203	89.2
Mason	Vallecito Creek near Julian	7	109	39.7

* Diversion and pumping for domestic and irrigation use 25 miles upstream.
** Diversion for irrigation 300 feet below gage.

Groundwater flows in the same general direction as surface water, to Clark Lake, Borrego Sink, and the Salton Sea.

However, this surface flow is affected by pumping and may be impeded by faults. About 10,000 acre-feet of subsurface flow reaches the Salton Sea annually. A safe yield of 22,000 acre-feet is estimated for the Planning Area. Storage capacity of the groundwater basin is estimated at 7 million acre-feet.

IMPERIAL VALLEY PLANNING AREA

This area includes the Imperial, Davies, and Amos-Ogilby hydrographic units. The Planning Area comprises 2,500 square miles in the southern portion of the Basin, almost all of it in Imperial County. The boundary coincides with the limits of the Imperial Valley watershed on the east and west and follows the International Boundary on the south. The Salton Sea shoreline forms the northwest end of the

Planning Area, and its main feature is the flat, fertile Imperial Valley formed by ancient Lake Cahuilla. The principal communities are El Centro and Brawley.

Surface Water Hydrology

Surface waters drain toward the Salton Sea. The New and Alamo Rivers, the main drainage courses drain surface runoff and agricultural irrigation return water from farmlands in the Imperial Valley and Mexico. The flow in the New River also contains sewage discharge from Mexicali, Mexico.

Average annual precipitation ranges from less than 3 inches over most of the hydrographic unit to about 8 inches in the Coyote Mountains on the western border.

Colorado River water, imported by the Imperial Irrigation District, is the main water supply and is used for irrigation and for industrial and domestic purposes. In 1970, the District imported 2.8 million acre-feet from the river to meet the water supply requirements in the Valley.

After the Central Arizona Project becomes operational, about the mid-1980s, and California's diversions from the Colorado River are reduced to the 4.4 million acre-feet per year basic appropriation, it is expected that diversions to the area will be reduced by a small amount to keep the total California agricultural uses within 3.85 million acre-feet per year. This limitation is the total of the first three priorities under the 1931 California 7-party water agreement.

Groundwater Hydrology

Groundwater is stored in the Pleistocene sediments in the valley floor, the mesas in the west, and the sand hills on the east. However, the fine lake sediments in the valley inhibit groundwater movement, and a tile-drain system is required to dewater the sediments to a depth below the root zone of crops and to prevent the accumulation of water on the surface.

Few wells have been drilled in these lake sediments because the yield is poor and the water is of inferior quality. The few wells in the valley are for domestic use only. In the Coyote Wells hydrologic subunit and Davies hydrologic unit, which are at higher elevations, the water yield from wells is higher and the quality better. Groundwater is the water supply in those areas.

Factors that diminish groundwater reserves are consumptive use, evapotranspiration, evaporation from soils where groundwater is near the surface, and losses through outflow and export. Groundwater outflow to the Salton Sea is about 2,000 acre-feet per year, and about 200 acre-feet is exported from the Planning Area.

The principal sources of recharge are percolation of runoff, and seepage from the irrigation canals.

SALTON SEA PLANNING AREA

The Salton Sea is a saline body of water in a natural sink between the Imperial and Coachella Valleys, in Riverside and Imperial Counties. The Sea is 30

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